Nipomo Mesa Management Area

13th Annual Report

Calendar Year 2020

Prepared by

NMMA Technical Group

Submitted April 2021

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Acronyms

AF	-	acre-feet
AFY	-	acre-feet per year
ALERT	-	Automated Local Evaluation in Real Time
CY		Calendar Year
C.E.G.	-	Certified Engineering Geologist
C.H.G.	-	Certified Hydrogeologist
CCAMP	-	Central Coast Ambient Monitoring Program
CDF	-	California Department of Forestry (now Cal Fire)
CIMIS	-	California Irrigation Management Information System
CPUC	-	California Public Utilities Commission
CU	-	consumptive use
D	-	Day
DPH	-	California Department of Public Health
DWR	-	California Department of Water Resources
ES	-	Executive Summary
Ft	-	Feet
ft^2	-	square feet
ft msl	-	feet above mean sea level
Gpd	-	gallons per day
GSWC	-	Golden State Water Company
K	-	hydraulic conductivity
MCL	-	Maximum Contaminant Level
mg/L	-	milligrams per Liter
MOU	-	memorandum of understanding
Msl	-	mean sea level
NCSD	-	Nipomo Community Services District
NCMA		Northern Cities Management Area
NMMA	-	Nipomo Mesa Management Area
NSWP	-	Nipomo Supplemental Water Project
TG	-	Nipomo Mesa Management Area Technical Group
P.E.	-	Professional Engineer
P.G.	-	Professional Geologist
PG&E	-	Pacific Gas & Electric
PWD		Public Works Department
RF	-	return flow
RP	-	reference point
RWC	-	Rural Water Company (now Golden State Water Company)
SCWC	-	Southern California Water Company (now Golden State Water Company)
SLO	-	San Luis Obispo
SLO PWD	-	San Luis Obispo County Public Works Department
SMVMA		Santa Maria Valley Management Area
SWP	-	State Water Project
TDS	-	Total Dissolved Solids
U.S.	-	United States
WWTF	-	wastewater treatment facility
WY	-	Water Year
Yr	-	year

Abbreviations

Blacklake WWTF	-	Blacklake Reclamation Facility
Cypress Ridge WWTF	-	Cypress Ridge Sewer Company's Cypress Wastewater Treatment Facility
Judgment	-	Judgment After Trial dated January 25, 2008
Phase III	-	Santa Maria Groundwater Litigation Phase III
Program	-	Nipomo Mesa Management Area Monitoring Program
Santa Maria Groundwater Litigation	-	*Santa Maria Valley Water Conservation District vs. City of Santa Maria, et al.* Case No. 770214
Southland WWTF	-	Southland Wastewater Treatment Facility
Stipulation	-	Stipulated Judgment dated June 30, 2005
Temp	-	Temperature
Woodlands	-	Woodlands Mutual Water Company
Woodlands WWTF	-	Woodlands Mutual Water Company Wastewater Reclamation Facility

Executive Summary

This 13th Annual Report, covering calendar year 2020 for the Nipomo Mesa Management Area (NMMA), is prepared in accordance with the Stipulation and Judgment for the Santa Maria Groundwater Litigation (Lead Case No. 1-97-CV-770214). The Annual Report provides an assessment of hydrologic conditions for the NMMA based on an analysis of the data accruing each calendar year. Each Annual Report is submitted to the court annually in accordance with the Stipulation in the year following that which is assessed in the report. This Executive Summary contains three sections: ES-1 Background; ES-2 Findings; and ES-3 Recommendations.

ES-1. Background

The Court established three management areas overlying the Santa Maria Groundwater Basin (SMGB). The NMMA lies between the Northern Cities Management Area (NCMA) to the north and the Santa Maria Valley Management Area (SMVMA) to the south. The NMMA Technical Group (TG) is one of three management area committees formed to administer the relevant provisions of the Stipulation. Golden State Water Company, Nipomo Community Services District, Phillips 66, and Woodlands Mutual Water Company are responsible for appointing the members of the committee, and along with an agricultural overlying landowner, who is also a Stipulating Party, are responsible for the preparation of this Annual Report. The goal of each committee is to promote monitoring and management practices in their respective management areas so that present and future water demands are satisfied without causing long-term damage to the underlying groundwater resource.

The TG, charged with developing the technical bases for sustainable management of the surface and groundwater supplies, prepared this 13th Annual Report – Calendar Year 2020. The TG collected and compiled data and reports from numerous sources including the NMMA Monitoring Parties, the Counties of San Luis Obispo (SLO) and Santa Barbara, the California Departments of Forestry, Water Resources, and Public Health, the State Water Resources Control Board, the U. S. Geological Survey, and the Engineers for the NCMA and SMVMA. The TG previously developed, and continues to update, and maintain an electronic database to aid in the evaluation of the long-term sustainability of the NMMA portion of the SMGB. The TG reviewed these data and reports and concluded that the development of additional data and evaluations will be on-going to aid the understanding of the hydrogeologic conditions of the NMMA and to make comprehensive recommendations for the long-term management of the NMMA.

The TG evaluated the available compiled data to reach the findings presented in the following section of this Executive Summary. The TG recognizes that the data used in the evaluations are not equally reliable but represent what is currently available. In some cases, additional analysis will be required for an adequate characterization of the physical setting within the NMMA, which will allow development of an appropriately detailed model of the stratigraphy that defines the location and thickness of production aquifers and confining layers. Refinements in the understanding of the physical setting will improve upon estimates of groundwater in storage available for pumping to meet water demands. Such work is an important goal for the TG and mirrors the TG's desire to characterize groundwater storage in the NMMA. The TG has developed specific recommendations to address these issues for the next Annual Report.

ES-2. Findings

Presented in this section of the Executive Summary are brief descriptions of the findings by the TG for Calendar Year (CY) 2020. Presented in the body of this report are the details and bases for these findings.

1. Severe Water Shortage Conditions continue to exist in the NMMA in calendar year 2020 as indicated by the Key Wells Index of 11.7 ft msl (see Section 7.2 Water Shortage Conditions).

2. The Nipomo Community Services District (NCSD) completed Phase I of the Nipomo Supplemental Water Project (NSWP). Water deliveries began on July 2, 2015, and 1,041 AF of imported water were delivered through the NSWP in CY 2020 (see Section 3.1.10 Imported Water).

3. Consistent with Stage IV of the NMMA Water Shortage Response Stages, a total reduction of 2,155 AF (-38%) in purveyor production was accomplished in 2020 as compared to 2013 (see Section 7.3.3 Stipulating Party Water Use Trends).

4. There is no evidence of seawater intrusion based on coastal water quality (see Section 6.1.2 Results from Coastal Monitoring Wells).

5. Total rainfall for CY 2020 is approximately 60 percent of the long-term average. The total rainfall for Water Year (WY) 2020 (October 1, 2019 through September 30, 2020) is approximately 100 percent of the long-term average (see Section 3.1.3 Rainfall).

6. The period of analysis (1975-2020) used by the TG is roughly 8 percent "wetter" on average than the long-term record (1920-2020) indicating there is a slight bias toward overstating the amount of local water supply resulting from percolation of rainfall (see Section 5.1 Rainfall and Percolation Past Root Zone).

7. The total estimated 2020 calendar year groundwater production is 14,313 acre-feet (AF). The breakdown by user and type of use is shown in the following table (see Section 3.1.9 Groundwater Production).

Agriculture	7,176 AF
Urban/Industrial	7,137AF
Total Production	**14,313 AF**

8. No surface water is diverted for water supplies in the NMMA (see Section 3.1.7).

9. The total Waste Water Treatment Facility effluent discharged in the NMMA was 657 AF for CY 2020 (see Section 3.1.11 Wastewater Discharge and Reuse).

10. Contour maps prepared using Spring and Fall 2020 groundwater elevation data suggest regional groundwater flow is generally from east to west (toward the ocean). The contour maps also show a landward gradient from the coast in the deep aquifer, which is an indication that groundwater flow is from the coastal area toward inland areas resulting in an increased potential for seawater intrusion. There exists a persistent pumping depression in the central area of the NMMA (see Section 6.1.3 Groundwater Contours and Pumping Depressions).

11. The 2020 acreage for land use classification of Urban is 10,596 acres; of Agriculture is 2,988 acres; and, of Non Irrigated is 7,957 acres (see Section 3.1.8 Land Use).

12. In 2020, water samples from some wells in both the shallow and deep aquifers had nitrate concentrations greater than the drinking water standard and samples from one well contained 1,2,3-Trichloropropane (1,2,3-TCP) at concentrations at or above the notification level. Shallow groundwater monitoring and remediation occurs at a near-coastal refinery, including at the site of a former leaking pipe where cleanup for metals and hydrocarbon contaminants in the shallow aquifer is ongoing (see Section 6.2.2 Results of Inland Water Quality Monitoring).

13. There continues to be uncertainty in the contribution from flow in Los Berros and Nipomo Creeks to the NMMA groundwater supply and quality. Stream stage data that indicate when flow is occurring are recorded at three gaging stations on Los Berros Creek. However, no rating curves are available to convert the stage data to stream flow. No stream gage exists on Nipomo Creek (see Section 2.3 Hydrogeology and Section 3.1.5 Streamflow).

14. There is a lack of detailed understanding about confined and unconfined aquifer conditions in the NMMA, except near the coast and locally adjacent areas where the deep aquifers are known to be confined (see Sections 2.3.1 Geology and 2.3.2 Groundwater Flow Regime).

15. There is a lack of detailed understanding of the flow path of rainfall, applied water, and treated wastewater to specific aquifers underlying the NMMA (see Section 2.3 Hydrogeology).

ES-3. Recommendations

A list of recommendations was developed and published in each of the previous NMMA Annual Reports. The TG will address past and newly developed recommendations based on future budgets, feasibility, and priority. The recommendations are subdivided into two categories: (1) Achievements from earlier NMMA Annual Report recommendations accomplished in 2020, and (2) Technical Recommendations – to address the needs of the TG for data collection and compilation.

ES-3.1. Achievements from Previous NMMA Annual Report Recommendations

The TG worked to address several of the recommendations outlined in the previous Annual Reports. Achievements made during 2020 are as follows:

- As part of the continued operation of the NSWP, a total of 1,041 AF of water was delivered to the NMMA during the CY 2020.
- A water level transducer and data logger were installed at one of the Key Wells (11N35W22C02) in late 2020.
- The TG continued review of the NMMA Monitoring Program to identify additional wells or monitoring points to include, in an effort to better characterize conditions in the shallow aquifer and to fill geographic data gaps associated with shallow and deep aquifers. The TG also approached and coordinated with SLO County, which resumed semi-annual monitoring of groundwater levels at a previous Key Well (11N35W23L01).

- To support certain estimates of groundwater production, the TG updated the classification of land use in the NMMA, which was last categorized in 2014, based on 2020 conditions.

- The TG continued tracking, in part through regular communication with San Luis Obispo County, groundwater management activities in groundwater basins adjacent to the SMGB upgradient of the NCMA. These activities are being implemented within the Arroyo Grande subbasin under the umbrella of California's Sustainable Groundwater Management Act.

- To better support evaluation of the potential for seawater intrusion, this report includes ion ratio time-series data for certain coastal wells and charts of ion ratio time-series data for other coastal wells.

ES-3.2. Technical Recommendations

The following technical recommendations are not organized in their order of priority, because the monitoring parties, considering their own particular funding constraints and authorities, will determine the implementation strategies and priorities.

- **Supplemental Water Supplies –** Reducing pumping is the most effective method to reduce the stress on the aquifers and to allow groundwater to recover; continued operation of the NSWP (see Section 1.1.5-Supplemental Water) is another viable method to achieve these goals. The TG recommends that this project continue to be implemented consistent with the Judgment and Stipulation.

- **Subsurface Flow Estimates –** Evaluate subsurface flow along the NMMA boundaries based on groundwater gradients and hydraulic conductivities in the shallow and deep aquifers.

- **Key Wells Monitoring –** Where possible, install data loggers in all Key Wells.

- **Key Wells Index 5-Year Review –** Evaluate and review the Key Wells Index by 2025.

- **Monitoring Points –** Replace the lost monitoring wells near Oso Flaco Lake. Select specific shallow dune sand aquifer wells for groundwater monitoring.

- **Well Reference Point Elevations – –** Continue to improve the accuracy of the RP elevations using LIDAR and other survey data.

- **Groundwater Production –** Develop a method to collect groundwater production data from all stipulating parties. Continue to update the land use classification on an interval commensurate with significant changes in land use patterns and as is practical, with the intention that the interval is more frequent than DWR's 10-year cycle of land use classification.

- **Agricultural Groundwater Production –** Continue to work with NMMA area farmers to measure groundwater production. Continue consultation with San Luis Obispo County Agriculture Department and other local experts in crop water use with specific updates to emerging crops and crop conversions.

- **Hydrogeologic Characteristics of NMMA –** Continue to review well screen intervals, lithology, groundwater level, and other relevant information. Improve the understanding of NMMA area fault displacements and potential effects of faulting on the hydrostratigraphy and groundwater flow in the NMMA.

- **Stream Flow Estimates – –** Develop rating curve for Los Berros Creek, and install a new stream sensor on Nipomo Creek and develop a rating curve.

- **Groundwater Modeling –** Continue to engage with users of utilizing the regional groundwater model developed for Pismo Beach and the South SLO County Sanitation District, to assess efforts to revise and update the accuracy of the model.

- **SGMA –** Continue communication between the TG and SLO County with respect to the County's groundwater management activity adjacent to the adjudicated portion of the SMGB. The TG will continue to report annual groundwater conditions to the DWR SGMA reporting site for adjudicated basins.

1. Introduction

The rights to extract water from the Santa Maria Groundwater Basin (SMGB) have been in litigation since the late 1990s. By stipulation and Court action, three separate management areas were established in 2008 as a result of such litigation: the Northern Cities Management Area (NCMA), the Nipomo Mesa Management Area (NMMA), and the Santa Maria Valley Management Area (SMVMA). The Court directed monitoring parties of each management area to form a group of technical experts to continue to study and evaluate the characteristics and conditions of each management area and to annually present their findings to the Court in the form of an Annual Report. The NMMA Technical Group (TG) is one of three management area committees formed to administer the relevant provisions of the Stipulation. Golden State Water Company (GSWC), Nipomo Community Services District (NCSD), Phillips 66 (P66), and Woodlands Mutual Water Company (Woodlands) are responsible for appointing members of the committee, together with an agricultural overlying landowner, who is also a Stipulating Party.

This 13th Annual Report – Calendar Year 2020 is a joint effort of the TG. The requirement contained in the Judgment for the production of an Annual Report is as follows:

> "Within one hundred and twenty days after each Year, the Management Area Engineers will file an Annual Report with the Court. The Annual Report will summarize the results of the Monitoring Program, changes in groundwater supplies, and any threats to groundwater supplies. The Annual Report shall also include a tabulation of Management Area water use, including Imported Water availability and use, Return Flow entitlement and use, other Developed Water availability and use, and Groundwater use. Any Stipulating Party may object to the Monitoring Program, the reported results, or the Annual Report by motion."

This Annual Report is organized into an executive summary, and nine sections which present: the general background of the litigation and some of the requirements imposed by the Court, a description of the basin, a summary of data collection, water supply and demand, hydrologic inventory, groundwater conditions, an analysis of water conditions, and a presentation of other considerations, recommendations, and references.

Five appendices are also included in the Annual Report: Appendix A – Monitoring Program, Appendix B – Water Shortage Conditions and Response Plan, Appendix C – Well Management Plan, Appendix D – Data Acquisition Protocols for Groundwater Level Measurements for the NMMA, and Appendix E – Additional Data. Twelve annual reports have previously been prepared, spanning calendar years 2008 to 2019 (NMMA, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, and 2020).

1.1. *Background*

Presented in this subsection is a brief history of the litigation process through 2008 and general discussions of activities that have been undertaken to date or are underway to manage the water resources of the NMMA.

1.1.1. History of the Litigation Process

The SMGB was the subject of litigation from 1997 to 2008. Collectively called the Santa Maria Groundwater Litigation (*Santa Maria Valley Water Conservation District vs. City of Santa Maria, et al.* Superior Court for the County of Santa Clara Case No. 770214), over 1,000 parties were involved with competing claims to pump groundwater from within the boundary of the SMGB (Figure 1-1).

The Santa Maria Valley Water Conservation District was originally concerned that banking of State Water Project (SWP) water in the groundwater basin by the City of Santa Maria would give the City of Santa Maria priority rights to the groundwater. The lawsuit was subsequently broadened to address groundwater management of the entire SMGB.

On June 30, 2005, the Stipulating Parties entered a Stipulated Judgment ("Stipulation") in the case, which was approved by the Court on August 3, 2005. The Stipulation divides the SMGB into three separate management sub-areas: the NCMA, NMMA, and the SMVMA. The Stipulation contains specific provisions with regard to rights to use groundwater, development of groundwater monitoring programs, and development of plans and programs to respond to Potentially Severe and Severe Water Shortage Conditions.

The TG was formed pursuant to a requirement contained in the Stipulation. Sections IV D (All Management Areas) and Section VI (C) (NMMA) contained in the Stipulation were independently adopted by the Court in the Judgment After Trial (herein "Judgment"). The Judgment is dated January 25, 2008, and was entered and served on all parties on February 7, 2008. It is noted that pursuant to paragraph 5 of the Judgment, the TG retains the right to seek a Court Order requiring non-stipulating parties to monitor their well production, maintain records thereof, and make the data available to the Court or the Court's designee. The compilation and evaluation of existing data, and the aggregation of additional data, are ongoing processes. Given its limited budget and resources, the TG has focused its efforts on the evaluation of readily accessible data. The TG does intend to slowly integrate into its assessment new data that may be collected from stipulating parties and other sources that were not previously compiled as part of the database existing in 2008. In November 2017 the Court's current presiding judge was given a day-long ground- and aerial-based tour of the SMGB, which was planned in the months leading up to November 2017.

1.1.2. Development of Monitoring Program

In 2008, the TG developed and the Court approved, the NMMA Monitoring Program ("Monitoring Program"), attached as Appendix A, to ensure systematic collection of important information in the basin. This Monitoring Program includes information such as groundwater elevations, groundwater quality, and pumping amounts. The Monitoring Program also identifies a number of wells in the NMMA to be monitored (Figure 1-2) and discusses the methods of analysis of the data.

A large areal extent within the NMMA receives water service from the major water purveyors (Figure 1-3). The majority of the lands within the NMMA obtain water by means other than from a purveyor. A fraction of these property owners are Stipulating Parties. All of the larger purveyors are also Stipulating Parties. All Stipulating Parties are obligated to make available relevant information regarding groundwater elevations, water quality, and pumping data necessary to implement the NMMA Monitoring Program.

1.1.3. Water Shortage Conditions and Response Plan

Pursuant to the Stipulation, the TG developed a Water Shortage Conditions and Response Plan that is included as part of the Monitoring Program. The water shortage conditions are characterized by two different criteria – those for Potentially Severe Water Shortage Conditions and those for Severe Water Shortage Conditions. The response to these conditions includes voluntary and mandatory actions by the parties to the Stipulation. The Court approved the Water Shortage Conditions and Response Plan on April 22, 2009 (see Appendix B).

1.1.4. Well Management Plan

The Stipulation requires the preparation of a Well Management Plan (WMP) when Potentially Severe Water Shortage Conditions or Severe Water Shortage Conditions exist prior to the completion of a Supplemental Water project. The WMP provides for steps to be taken by the NCSD, GSWC (formerly named Southern California Water Company [SCWC]), and Woodlands, under these water shortage conditions. The WMP has no applicability to either P66 or Overlying Owners as defined in the Stipulation. The WMP was adopted by the TG in January 2010 and submitted to the Court in April 2010 with the 2009 Annual Report, and is attached as Appendix C to this report. On April 14, 2014, the NMMA Water Shortage Response Stages were endorsed by the TG and submitted to the Court with the 2013 Annual Report (see Appendix C).

1.1.5. Supplemental Water

To bring Supplemental Water to the NMMA, pursuant to the Stipulation:

> "The NCSD agrees to purchase and transmit to the NMMA a minimum of 2,500 acre-feet of Nipomo Supplemental Water each Year. However, the NMMA Technical Group may require NCSD in any given Year to purchase and transmit to the NMMA an amount in excess of 2,500 acre-feet and up to the maximum amount of Nipomo Supplemental Water which the NCSD is entitled to receive under the MOU if the Technical Group concludes that such an amount is necessary to protect or sustain Groundwater supplies in the NMMA. The NMMA Technical Group also may periodically reduce the required amount of Nipomo Supplemental Water used in the NMMA so long as it finds that groundwater supplies in the NMMA are not endangered in any way or to any degree whatsoever by such a reduction."

> "Once the Nipomo Supplemental Water is capable of being delivered, those certain Stipulating Parties listed below shall purchase the following portions of the Nipomo Supplemental Water Yearly:

> NCSD - 66.68%
> Woodlands Mutual Water Company - 16.66%
> SCWC - 8.33%
> Rural Water Company - 8.33%"

The Judgment states: "The court approves the Stipulation, orders the Stipulating Parties only to comply with each and every term thereof, and incorporates the same herein as though set forth in full." Thus, the terms of the Stipulation as herein stated must be complied with in accordance with the order of the Court.

NCSD completed the initial phase of the planned 3,000 AFY Nipomo Supplemental Water Project (NSWP) in 2015 and began delivering water onto the NMMA on July 2, 2015. With the initiation of NSWP deliveries, a minimum purchase schedule 'time clock' was triggered in accordance with the NCSD and City of Santa Maria Wholesale Agreement (NCSD and City of Santa Maria, 2013). Commencing no later than delivery year eleven (2026), NCSD is required to purchase from the City of Santa Maria (and import to the NMMA) a minimum of 2,500 AFY.

The initial phase of the NSWP included the construction of a two-mile long pipeline that traverses under the Santa Maria River, across the Santa Barbara/San Luis Obispo County boundary and interconnects the City of Santa Maria's water system to NCSD's. This interconnect provides the NMMA with its first and only means of importing water and links the NMMA via the City of Santa Maria and the State Water Project to Northern California. This pipe is capable of delivering 6,200 AFY. The License Agreement the County of Santa Barbara issued to facilitate the pipeline crossing the County's flood control levee constrains the project to a maximum delivery of 3,000 AFY.

NCSD is planning additional phases of work to ramp up capacity well ahead of the minimum purchase schedule contained in the Wholesale Agreement.

1.1.6. Other Groundwater Management Activities

San Luis Obispo County Public Works Department (SLO PWD) performs, among other activities, services related to administration and operation of various water and wastewater wholesale and retail facilities, as well as long term master water planning. Consistent with these activities, SLO PDW is the lead agency for the 2019 San Luis Obispo County Integrated Regional Water Management (IRWM) Plan, which covers the SLO County region. The revised SLO County Final 2019 IRWM Plan was completed in August 2020.

The SLO County IRWM Region received $1 million in Proposition 84 Round 2 Planning Grant funding in late 2012. This funding was set aside for updating the County's 2007 IRWM Plan and for six planning studies, including characterization of the SMGB, to help to address key planning needs in the county. The County's groundwater basin characterization activities, which are also known as the SMGB Characterization and Planning Activities Study, were intended to support development of a groundwater flow model and Salt and Nutrient Management Plan for the NCMA and NMMA portions of the SMGB (FUGRO, 2015).

As part of the County's groundwater basin characterization activities, the TG previously provided the County's groundwater basin characterization consultant with various data, including, but not limited to, lithologic (well) logs, geophysical logs, and pump efficiency and aquifer test results. And, NCSD and GSWC provided access in 2014 for aquifer testing of selected wells during execution of the groundwater basin characterization activities. The TG subsequently provided comments on draft versions of the SMGB Characterization and Planning Activities Study report, which was made available to the public and the TG as a final version in January 2016.

SLO County began developing a regional groundwater model in 2017. The active model domain covers the NCMA, NMMA, and a portion of the SMVMA north of the Santa Maria River. The model utilizes a significant amount of information presented in the SMGB Characterization and Planning Activities Study report among other sources. The TG provided model input data and a TG representative provided input via participation in frequent meetings. The TG also provided other feedback on the model development process in 2017 and 2018 by reviewing key documents and providing written comments to the groundwater modeling team, and provided comments and concerns during the final model calibration phase in 2019. The model was completed in 2019 (Geoscience, 2019).

SLO PWD is also taking a leading role with respect to initiating the implementation of the state of California's Sustainable Groundwater Management Act (SGMA) in applicable groundwater basins. SGMA, which was signed into law in September 2014 and enacted beginning January 1, 2015, established a new structure for managing California's groundwater resources at a local level. SGMA requires the formation of locally-controlled groundwater sustainability agencies (GSAs) in certain groundwater basins. And, SGMA requires that GSAs develop and implement a groundwater sustainability plan (GSP) to meet the sustainability goal of the basin or subbasin, to ensure that it is operated within its sustainable yield, without causing undesirable results.

In 2015, to comply with SGMA requirements, the SLO County and Flood Control District Board adopted a strategy which seeks to establish community focused GSAs based on cooperative interagency and stakeholder relationships. Although most of the Santa Maria Valley Groundwater Basin is exempt from the SGMA, there are non-adjudicated portions (i.e., "fringe areas") that lie outside of the adjudicated portion of the basin that are subject to SGMA (GSI, 2018a and 2018b; SLO, 2019b). These fringe areas include an area of about 6,200 acres east of Nipomo Creek and the NMMA, known as the Nipomo Valley fringe area. Based on DWR's decisions in February 2019 on the final 2019 basin boundary modification processes, three of the Santa Maria River Valley Basin fringe areas, including the Nipomo Valley, were removed from the basin. As a result, groundwater in the Nipomo Valley will not be subject to the SGMA process. The TG reviewed and provided comments to the public draft documents prepared by the SLO County for the basin boundary modification.

1.2. *Reporting*

The Annual Report is prepared and internally reviewed by the TG and is subsequently made available to the Court and public, as described below.

1.2.1. Description of the Nipomo Mesa Management Area Technical Group

The TG is composed of representatives of each of the Monitoring Parties: NCSD, GSWC, P66 (formerly named ConocoPhillips), Woodlands; and an agricultural user that is also a Stipulating Party. The agricultural overlying landowner representative is not responsible for funding a portion of the TG's efforts.

In October 2015, GSWC acquired the Rural Water Company (RWC) drinking water system, not including the wastewater treatment and disposal facilities. Because GSWC began operating the former RWC drinking water system at that time, late in the calendar year, and to provide greater clarity, attribution to RWC was made throughout the 2015 Annual Report wherever possible. In the interest of simplification, references in subsequent annual reports to RWC have been removed and replaced with references to GSWC.

The TG is responsible for developing the Monitoring Program, implementing the Monitoring Program, and preparing the Annual Report. Unanimous approval on all material issued is obtained by way of a single vote per Monitoring Party. If the TG is unable to obtain unanimous approval, the matter may be taken to the Court for resolution.

The Monitoring Parties may hire individuals or consulting firms to assist in the preparation of the Monitoring Program and Annual Reports (the Judgment describes these individuals or consulting firms as the “Management Area Engineer”). The Monitoring Parties’ representatives to the TG, as a group, function as the Management Area Engineer (Table 1-1) and attend monthly meetings where data collection and preparation of the Annual Report are the primary focus. The Monitoring Parties have the sole discretion to select, retain, and replace the Management Area Engineer.

Table 1-1. NMMA Technical Group

Monitoring Parties	Management Area Engineer Representatives
Agricultural Overlying Landowner	Jacqueline Frederick, J.D.
Golden State Water Company	Toby Moore, Ph.D., P.G., C.H.G.
	Robert Collar, P.G., C.H.G.
Nipomo Community Services District	Brad Newton, Ph.D., P.G.
Phillips 66	Steve Bachman, Ph.D., P.G.
	Norm Brown, Ph.D., P.G.
Woodlands	Rob Miller, P.E.
	Tim Cleath, P.G., C.H.G., C.E.G.
Note: Each Monitoring Party has a single vote in order to unanimously approve final work product.	

1.2.2. Coordination with Northern Cities and Santa Maria Valley Management Areas

The NMMA is bounded on the north by the NCMA and on the south by the SMVMA (Figure 1-1). The TG recognizes that collaborative technical efforts with the NCMA and SMVMA technical groups will be important to the appropriate management of the basin. Examples of collaborative efforts include:

- Sharing and evaluating technical data throughout the year, and during the preparation of Annual Reports,
- Opportunities for review and comment on technical work products,
- Sharing of protocols and standards for data collection and analysis, and
- Consideration of jointly-pursued projects and grant opportunities.

As the conditions of the existing basin underlying the NMMA are described in subsequent sections, periodic reference will be made to the Annual Reports produced by the two neighboring technical groups.

1.2.3. Distribution

The Annual Report for each calendar year (January 1 to December 31) is completed by April 30th of the following calendar year and submitted to the Court. Beginning in 2016, and in compliance with SGMA, the Annual Report, along with select information extracted from the Annual Report, has been published to the California Department of Water Resources’ website for adjudicated groundwater basins (DWR, 2019).

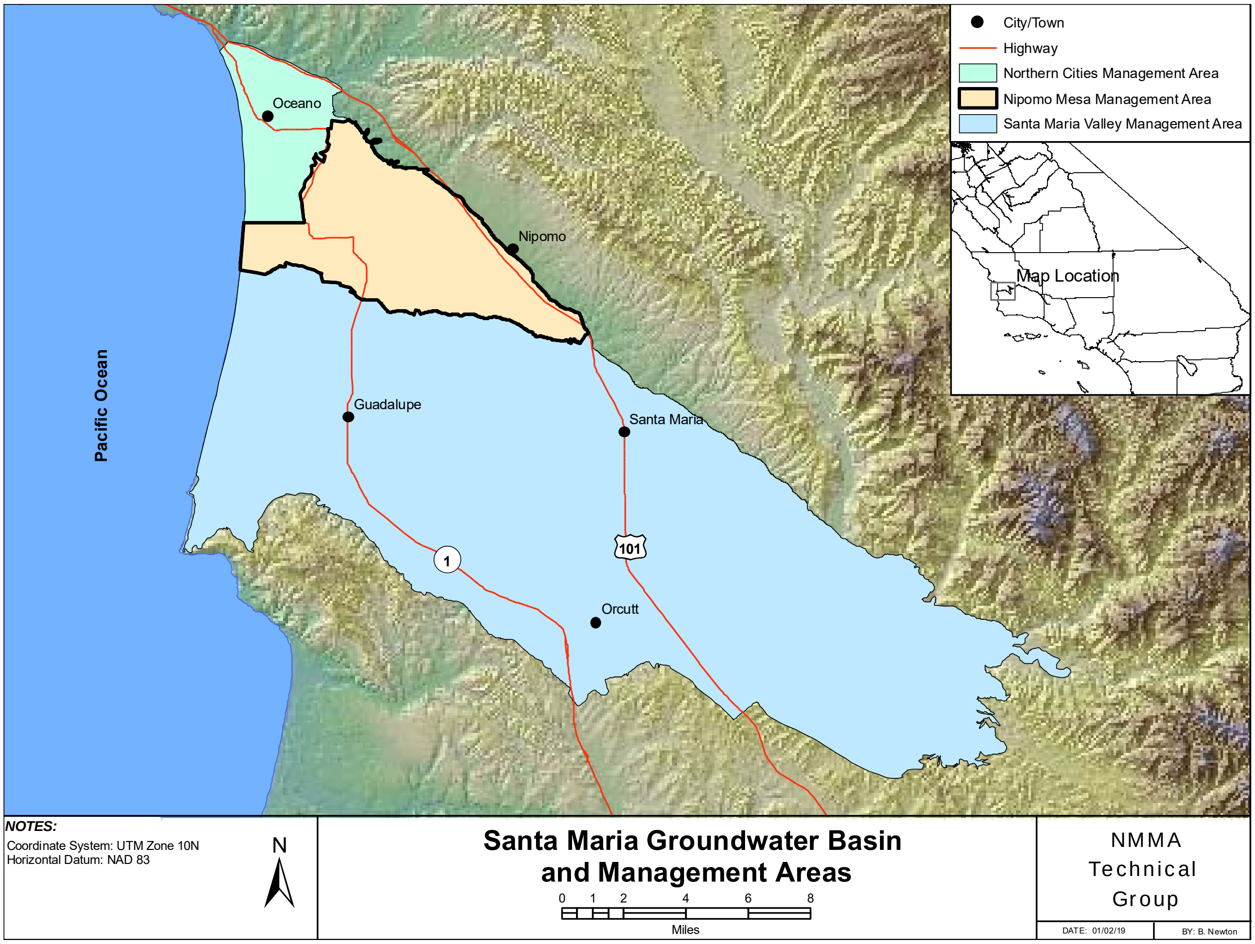

Figure 1-1. Santa Maria Groundwater Basin and Management Areas

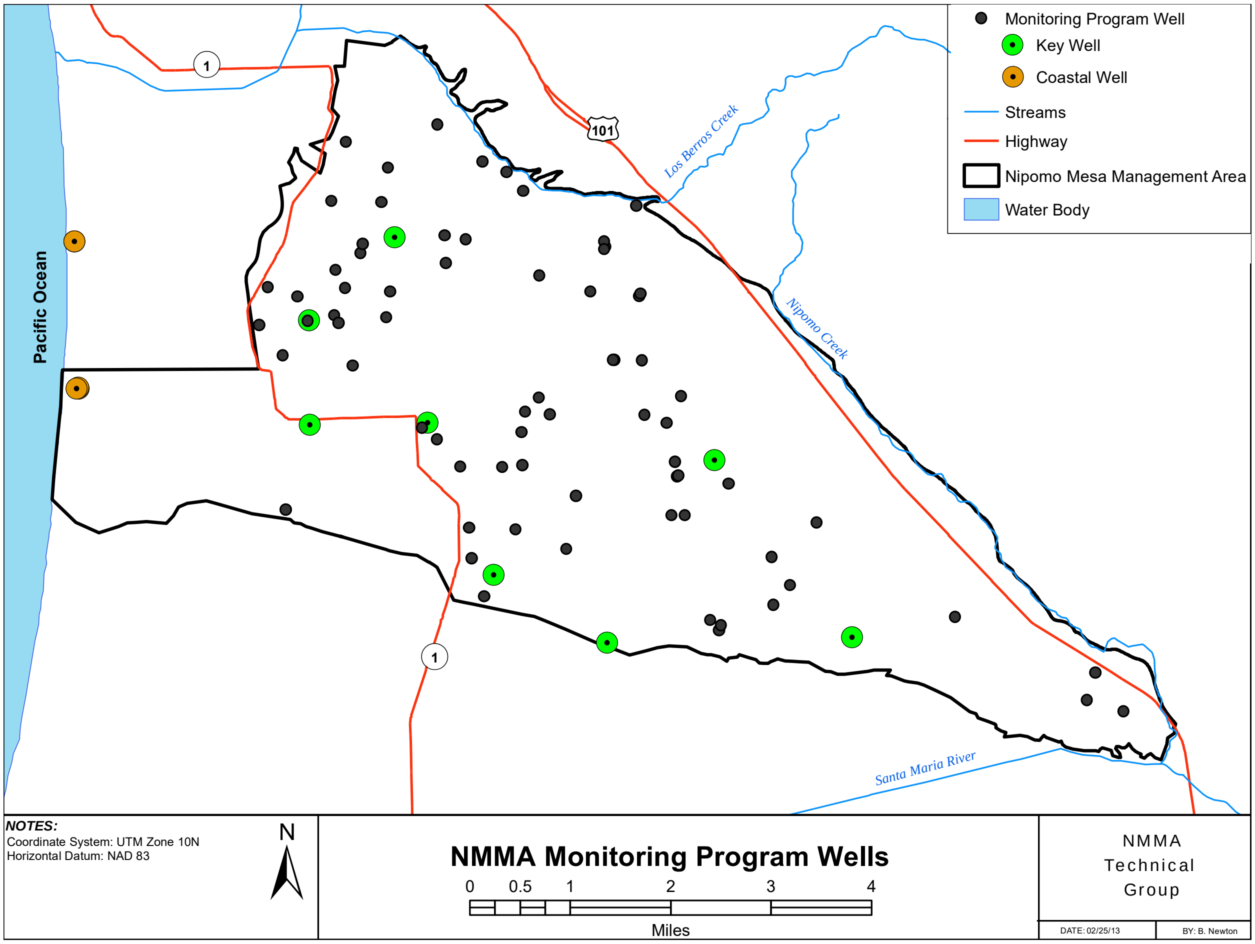

Figure 1-2. Wells identified in the NMMA Monitoring Program (NMMA, 2009)

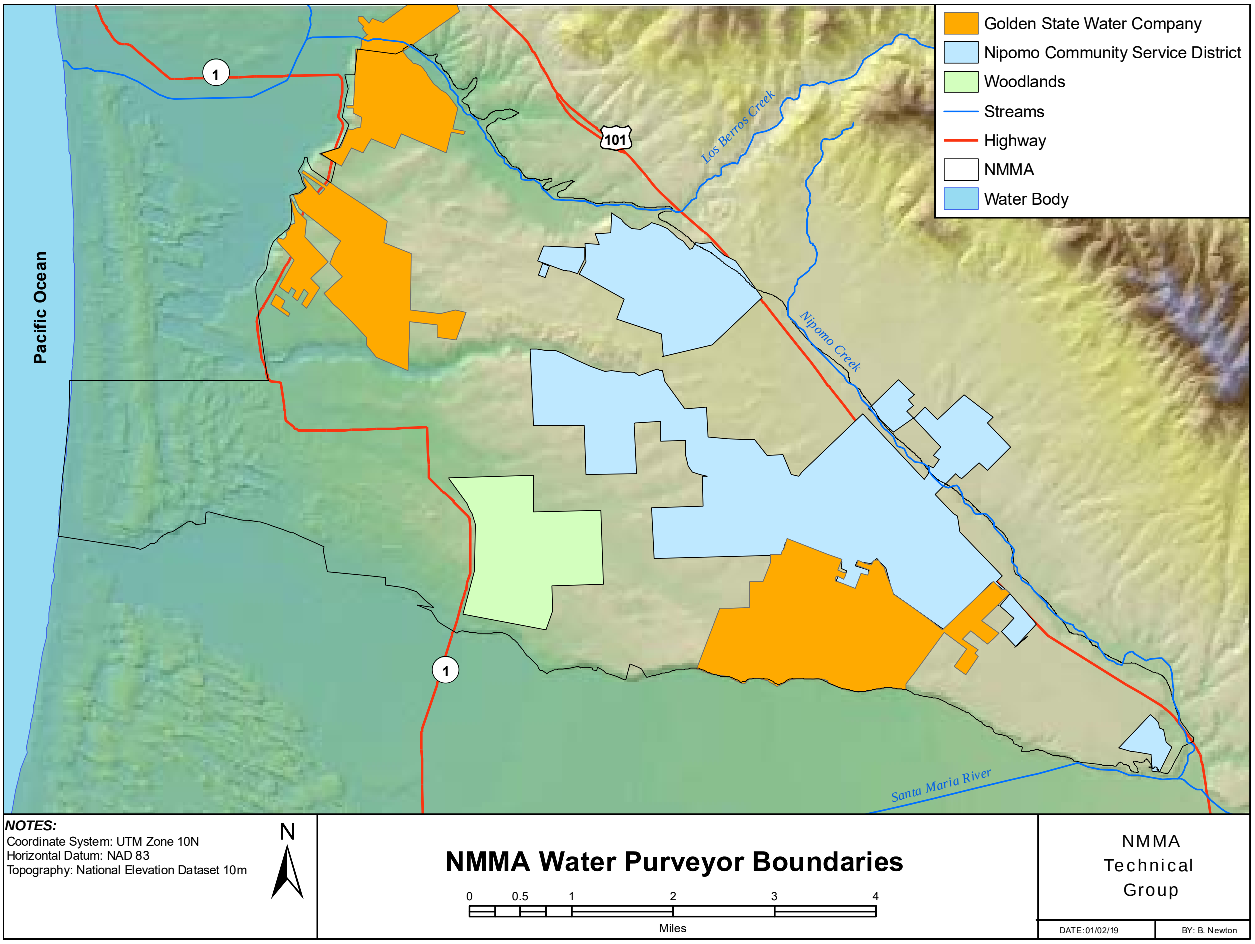

Figure 1-3. NMMA Water Purveyor Boundaries

2. Basin Description

The SMGB, covering a surface area of approximately 256 square miles, is bounded on the north by the San Luis and Santa Lucia mountain ranges, on the south by the Casmalia-Solomon Hills, on the east by the San Rafael Mountains, and on the west by the Pacific Ocean. The basin receives water from rainfall directly and runoff from several major watersheds drained by the Cuyama River, Sisquoc River, Arroyo Grande Creek, and Pismo Creek, as well as many minor tributary watersheds. Sediment eroded from these nearby mountains and deposited in the Santa Maria Valley formed beds of unconsolidated alluvium, averaging 1,000 feet in depth, with maximum depths up to 2,800 feet and comprise the principal production aquifers from which water is extracted to supply the regional demand. Three management areas were defined to recognize that the development and use of groundwater, State Water Project water, surface water storage, and treatment and distribution facilities have historically been financed and managed separately, yet they are all underlain by, or contribute to the supplies within, the same groundwater basin.

2.1. *Physical Setting*

The NMMA has physical characteristics which are distinct from the other two management areas. It is largely a mesa area that is north of the Santa Maria River, west of the San Luis Range and south of the Arroyo Grande Creek, with a lower lying coastal environment to the west. The mesa was formed when the Santa Maria River and Arroyo Grande Creek eroded the surrounding area. The current coastal environment developed subsequently, is composed of beach dunes and lakes, and is a recreational area with sensitive species habitat. Locally, hummocky topography on the mesa area reflects the older dune deposits. Black Lake Canyon is an erosional feature north-central in the NMMA and where the dune deposit thickness is exposed. Los Berros Creek valley is along the north side of the NMMA and the Nipomo Creek valley is along the east side of the NMMA.

2.1.1. Area

The NMMA covers approximately 33 square miles or 21,590 acres, which accounts for approximately 13 percent of the overall SMGB (164,000 acres). Approximately 13,500 acres on the NMMA, or 64 percent, is developed land requiring water pumped from the underlying aquifers to sustain the agricultural and urban development. In the 2018 Annual Report, the common boundary between the NMMA and the SMVMA was changed to follow parcels, in coordination with SMVMA Engineer.

2.1.2. General Land Use

Land uses include agricultural, urban (residential and commercial), and native or undeveloped areas. There are also three golf courses and one oil-processing facility. The crop types grown in the order of largest acreage were strawberries and cane berries, nursery, rotational vegetables (broccoli, lettuce, etc.) avocado and lemon, pasture, deciduous and grapes, and most recently cannabis. The most recent survey of crops was performed in 2020.

2.2. *Climate*

A Mediterranean-like climate persists throughout the area with cool moist winters and warm dry summers. During the summer months, the warm air inland rises and draws in the relatively cooler marine layer near the coastline keeping summer cooler and providing moisture for plant growth, while in the winter months the relatively warmer ocean temperature keeps the winter warmer. The average annual maximum temperature is 69 degrees Fahrenheit, and the average annual minimum temperature is 46 degrees Fahrenheit. Precipitation normally occurs as rainfall between November and April when cyclonic storms originating in the Pacific Ocean move onto the continent. The long-term (1958 to 2020) average annual rainfall reported at CDF Nipomo Rain Gauge #151.1 is 15.65 inches and is representative of the larger area of the NMMA. Rainfall variability exists across the NMMA and rainfall increases in the foothills and mountains due to the orographic (elevation) effect. The long-term average annual evapotranspiration from standard turf (a well-watered, actively growing, closely clipped grass that is completely shading the soil) is 46.3 inches, and is referred to as the reference evapotranspiration of Reference Zone 3 (Table 2-1).

Table 2-1. Climate in the Nipomo Mesa Area

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max Temp (Fahrenheit)[1]	63.3	64.3	64.8	66.9	68.3	70.6	72.8	73.2	74.4	73.5	69.2	64.3	68.8
Average Min Temp (Fahrenheit)[1]	39.0	40.9	42.0	43.5	46.8	50.1	53.1	53.6	52.2	48.1	42.6	38.7	45.9
Average Rainfall (inches)[2]	3.27	3.18	2.81	1.08	0.27	0.04	0.02	0.03	0.18	0.71	1.52	2.52	15.65
Monthly Average Reference Evapotranspiration (inches)[3]	1.86	2.24	3.72	4.80	5.27	5.70	5.58	5.27	4.20	3.41	2.40	1.86	46.3
Monthly Average Reference Evapotranspiration (inches)[4]	2.13	2.87	2.96	4.41	5.7	5.02	5.09	4.56	3.16	2.98	2.37	2.09	43.34
Monthly Average Reference Evapotranspiration (inches)[5]	3.81	3.65	3.90	4.38	4.90	4.57	4.49	4.26	3.80	3.73	3.60	3.51	48.60

Notes:
1. Data from Santa Maria Airport - Nearest long-term temperature record to the NMMA in the Western Regional Climate Center is from the Santa Maria Airport, station #47946. The average is from 1948 through 2016. Source: http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca7946.
2. Data from CDF Nipomo Rain Gauge 151.1 (1959 to 2020).
3. Data from California Irrigation Management Information System (CIMIS) – Reference Zone 3 Source: http://wwwcimis.water.ca.gov/App_Themes/images/etozonemap.jpg
4. Data from California Irrigation Management Information System (CIMIS) calculated from monthly evapotranspiration (ET_o) for the period of record at Station 202 Nipomo (June 2006 to December 2020), and the station is regularly over-sprayed by irrigation. Source: http://www.cimis.water.ca.gov/cimis/data.jsp
5. Data from California Irrigation Management Information System (CIMIS), calculated from monthly evapotranspiration (ET_o) for the period of record at Station 232 Santa Maria II (April 2011 to December 2020). Source: http://www.cimis.water.ca.gov/cimis/data.jsp

2.3. *Hydrogeology*

Groundwater management is founded upon the current understanding of the geology and the groundwater flow regime specific to the NMMA. Two recent investigations of the hydrogeology within the SMGB build on the historic understanding. The Geoscience Phase 1B hydrogeologic investigation led to the preparation of a conceptual hydrogeologic model across a study area that includes the NMMA (Geoscience, 2018). The City of Pismo Beach contracted with Ramboll Group to perform “SkyTEM” aerial resistivity survey of the non-urban areas of South County in 2020.

2.3.1. Geology

The NMMA overlies part of the northwest portion of the SMGB (Figure 1-1). The sedimentary deposits comprising the principal production aquifers of the groundwater basin underlying the NMMA include the Pliocene age Careaga Formation and the Plio-Pleistocene age Paso Robles Formation. These basin sedimentary formations are overlain by Quaternary age dune sands in the NMMA, and by the

Quaternary age alluvium in Los Berros Creek valley (in the northern perimeter of the NMMA) and in Nipomo Creek valley (on the east perimeter of the NMMA) which, when saturated, comprise shallow production aquifers locally. These sedimentary beds have been deposited within the Santa Maria Valley synclinal basin. The pre-Quaternary age sedimentary beds have been displaced by faults within and on the perimeter of the basin (Figure 2-1). Further information on these geologic formations and the geologic structure is available in the 2nd Annual Report – Calendar Year 2009 (NMMA, 2010). Cross sections developed by the TG characterize portions of the NMMA boundary, were prepared to advance the understanding of hydrogeology, and are plotted on the generalized geologic map (Figure 2-1).

Northwestern Boundary

The A-A' geologic cross section generally follows the northwestern boundary of the NMMA from Los Berros Creek and Nipomo Hill in the north to Black Lake Canyon and State Route 1 (Figure 2-2). The cross section was prepared based on well logs and geologic maps as a foundation for evaluating groundwater flow in this area. It was developed primarily using 19 wells distributed from north to south along, and located within roughly one half mile east (primarily) and west of the approximately 4-mile-long cross section. The wells and associated lithology were not included on the cross section at that time because they were considered confidential according to the California Water Code.

The cross section generally shows the land surface, relatively permeable aquifers tapped by many wells in the area that are underlain by relatively impermeable bedrock of the Franciscan Formation, and the Oceano fault. Younger Alluvium, Dune Sand and Older Dune Sand deposits (the Dune Sand and Older Dune Sand Formations are collectively referred to in this report as the "shallow dune sand aquifer"), Paso Robles Formation (clay and gravel beds), and underlying marine sands of the Careaga Formation contain aquifers. The base of the Older Dune Sand Formation slopes to the southwest from where it laps onto the Nipomo Hill bedrock at an elevation of more than 100 feet above sea level to an elevation of about 100 feet below sea level at the southern end of the cross section. The Paso Robles and Careaga Formation beds also slope to the southwest from Nipomo Hill toward Black Lake Canyon, where the base of these formations drops to an elevation of at least about 400 feet below sea level but is not well defined.

The relatively impermeable bedrock is comprised of the Cretaceous and Jurassic age Franciscan Complex rock and older sedimentary beds (early Pliocene age Sisquoc Formation). Very few wells produce groundwater from the bedrock in the NMMA. Franciscan Complex bedrock is exposed on the lower slope of Nipomo Hill at Los Berros Road and remains at relatively shallow depths, within a few hundred feet of the land surface, toward the south to Woodland Hills Road. Older sedimentary beds that thicken toward the coast, have low permeability and underlie the principal aquifers. These older sedimentary beds, though not as impermeable as the Franciscan Complex rock, contain poorer quality groundwater than the overlying Paso Robles and Careaga Formations comprising the principal production aquifers.

Southern Boundary

The B-B' geologic cross section generally follows the southern boundary of the NMMA and is based on available subsurface information from exploratory oil well logs, water well logs, published geology and hydrogeologic reports, and geophysical surveys (Figure 2-3). The aquifers depicted extend both to the south and north of the SMVMA - NMMA boundary and groundwater flow can be expected to occur across this boundary. Groundwater flow may be impeded by geologic features including near-vertical boundaries such as faults and near-horizontal aquitards that are illustrated on this cross section.

The stratigraphy in this area is similar to that described for the A-A' cross-section. Here however, the thickness of the deep aquifer is much greater, on the order of 500 feet in many places. The shallow dune sand aquifer, overlying the deep aquifer, increases in saturated thickness from approximately 50 feet on the east to 300 feet on the west.

Cross section B-B' shows the land surface, the relatively permeable aquifers utilized by many wells in the area, and the underlying, relatively impermeable, undifferentiated Tertiary sedimentary beds. Younger Alluvium, Older Dune Sand Formation, Paso Robles Formation (clay and gravel beds), and underlying marine sands of the Careaga Formation contain aquifers. The base of the Older Dune Sand slopes toward the coast, from where it laps onto the Franciscan bedrock east of the Wilmar Avenue fault near Highway 101 at an elevation of more than 100 feet above sea level to an elevation of about 100 feet below sea level at the western end of the cross section. The Paso Robles and Careaga Formation beds also slope toward the coast, where the base of these formations is at an elevation of at least about 800 feet below sea level. The Oceano, Santa Maria River, and Wilmar Avenue faults appear to displace the basin sediments with an apparent upward offset to the east.

Northern Boundary

Geologic cross-section C-C' generally follows the northern edge of the Nipomo Mesa, from Nipomo Hill at the west end to Summit Station at the east end, along the Los Berros Creek valley (Figure 2-4). The cross section was prepared based on well logs and geologic maps as a foundation for understanding basin characteristics and to evaluate groundwater flow from the Los Berros Creek alluvium into aquifers within the NMMA. The cross section shows the water-bearing formations above the underlying bedrock.

In addition to the alluvium, the water-bearing formations along cross-section C-C' include the Older Dune Sand Formation and clay and gravel beds of the Paso Robles Formation. The underlying Careaga Formation appears to be absent or very thin in this area. The base of the Dune Sand slopes to the southwest, orthogonal to cross-section C-C', from where it laps onto the Nipomo Hill bedrock at an elevation of more than 100 feet above sea level, to near El Campo Road at an elevation of about 50 feet above sea level. The base of the Paso Robles Formation from El Campo Road to Pomeroy Road is 50-100 feet below sea level and rises east from Pomeroy Road to an elevation of more than 150 feet above sea level.

The bedrock along cross-section C-C' is primarily the Cretaceous age Franciscan Assemblage rock, although drilling logs identify "blue clay" and "shale" that could be more recent low permeability consolidated sedimentary beds of the Sisquoc and possibly the Monterey Formations.

The TG's understanding of the subsurface conditions indicated by a review of geologic maps (Hall, 1974; DWR, 1970; and DWR, 2002) and well completion reports suggests that the base of the permeable sediments in the Nipomo Hill area is approximately 100 feet above sea level. This interpretation differs from the 2015 SMGB characterization study (FUGRO, 2015) which represents the base of the permeable sediments in this area to be much deeper (100 feet below sea level or deeper).

Eastern Boundary

Geologic cross-section D-D', close to the eastern boundary of the NMMA from the Santa Maria River valley to Los Berros Creek valley, illustrates the uplifted basin sediments resting on predominantly Franciscan Assemblage bedrock (Figure 2-5). Basin sediments along this cross-section include Older Dune Sands Formation, Paso Robles Formation, and a relatively thin section of the Careaga Formation. The base of the basin sediments is at an elevation of about 150 feet above sea level from Los Berros

Creek to where Highway 101 veers to the east off of the cross-section alignment. Southeast of this location, the base of the basin sediments deepens to an elevation of about 50 feet above sea level.

The potentially water-bearing formations along cross-section D-D' include the Older Dune Sand Formation, clay and gravel beds of the Paso Robles Formation, and a thin (20-50 feet thick) marine sand unit of the Careaga Formation. The Dune Sands deposits are typically unsaturated and the Paso Robles Formation terrestrial sedimentary beds are only partially unsaturated and tend to be fine grained. The Careaga sands are saturated.

Differentiation of Older Dune Sand Formation from Paso Robles Formation

The geologic map (Figure 2-1) shows that Dune Sand and Older Dune Sand Formation extend over the entire mesa area, except for the Los Berros Creek valley and a small area in Black Lake Canyon. The Dune Sand Formation includes active sand dunes whereas the Older Dune Sand Formation is comprised of typically very fine to medium grained sands with some interbedded older soil horizons and inter-dune silts and clays. The elevation of the contact between Older Dune Sand Formation and the Paso Robles Formation was determined in each well where possible (Figure 2-6).

The geologic cross sections in the Santa Maria Groundwater Basin Characterization and Planning Activities Study illustrate that the Older Dune Sand Formation deepen toward the southwest. Beneath the Older Dune Sand Formation, these cross sections also show that there are clayey sediments that separate shallow dune sand aquifer from the deeper Paso Robles Formation aquifers in most areas (Fugro, 2015). The area of significant saturated shallow dune sand aquifer thickness (typically greater than 50 feet), where wells can produce more than a few gallons per minute, is in the southwest portion of the NMMA.

Faulting

The Oceano fault (U.S. Geological Survey and California Geological Survey, 2006) trends northwest-southeast as it crosses the NMMA boundary near Woodland Hills Road and Kip Lane. Vertical offset of the Paso Robles and Careaga Formations and the Older Dune Sand Formation along the northwestern boundary of the NMMA is approximately 150 feet (Figure 2-2). A seismic (geophysical) survey line transecting the NMMA suggests that the Oceano fault displaced Older Dune Sand Formation (PG&E, 2014), but the nature of offset of the Paso Robles Formation and the Older Dune Sand Formation along the southern boundary of the NMMA, if any, is not known (Figure 2-3). Vertical offset of the Tertiary - Quaternary contact is estimated to be 250-415 feet and an even greater offset is observed at the top of the Franciscan Assemblage (Hanson et al, 1994). The PG&E fault maps for the Offshore Geologic Mapping Study show the offshore Oceano fault as comprised of two splays near the coastline, which extend onshore through the NMMA: the Oceano fault and the Santa Maria River fault. Offset along the Oceano fault has relatively down-dropped aquifers on the southwest side of the structure. The Santa Maria River fault strand is shown to split off of the Oceano fault about ½ mile east of the coast and diverges north from the Oceano fault as it crosses the NMMA (PG&E, 2014).

Offshore, a boundary or change to the groundwater basin may be closer to shore than previously understood. Formerly, the basin limit was considered to be the Hosgri fault, which is about 10 miles offshore. However, the PG&E study recognizes the Shoreline fault, about four miles west of the coastline, as an active fault with significant displacement of basin sediments (PG&E, 2014).

2.3.2. Groundwater Flow Regime

Groundwater flows within the NMMA from recharge sources toward areas of groundwater discharge. Groundwater flow is controlled by:

- hydraulic head (e.g., recharge and pumping),
- impediments to flow (e.g., aquitard),
- preferential flow paths (e.g., buried gravel channel deposits), and
- geology (e.g., geologic facies, contacts, or tilted beds).

Groundwater elevation hydrographs show measured groundwater elevations over time within the specific aquifers tapped by a well and are site-specific for specific times. Groundwater elevation measurements within an aquifer are mapped and interpreted to develop groundwater contours (see Section 6.1.3 Groundwater Contours and Pumping Depressions). Groundwater contour maps provide an interpreted understanding of the hydraulic head conditions within specific aquifer zones.

The following paragraphs present our current understanding of the groundwater flow regime. This understanding includes groundwater flow along the boundaries of the NMMA and groundwater flow within the NMMA.

Groundwater Flow at the NMMA Boundary

The NMMA area encompasses only part of the SMGB. Groundwater flow between adjacent portions of the basin can be expected to occur, but less subsurface flow is likely to occur along bedrock basin edges than between areas where there is continuity of the aquifers.

The eastern boundary of the NMMA is approximately coincident with Nipomo Creek in Nipomo Valley (Figure 2-5). Groundwater recharge from the creek may occur through the shallow alluvial deposits but minimal subsurface inflow into the NMMA area occurs from the bedrock underlying the creek.

The northern boundary of the NMMA is coincident with the northern edge of the Los Berros Creek valley alluvium – Paso Robles Formation boundary within Los Berros Creek valley (Figure 2-4). The alluvium receives recharge from Los Berros Creek. Formations north of the Los Berros Creek valley include sedimentary deposits and underlying Franciscan Complex, where groundwater flow from these formations to the NMMA is likely negligible.

The northwest boundary of the NMMA is at the base of the mesa along the Cienega Valley of Arroyo Grande Creek. Groundwater flow across this boundary can occur, and may be affected by the Oceano and Santa Maria River faults. There is no appreciable flow from the bedrock outcrop at Nipomo Hill. A cross section along the north edge of the mesa was developed to aid in characterization of the subsurface geology (Figure 2-2). Flow from the shallow dune sand aquifer recharges the dune lakes west of this boundary. Hydrogeologic parameters and groundwater level contour maps are the basis for evaluation of the amount of groundwater flow that occurs across this interface between the NMMA and the NCMA (see Section 5.2 Subsurface Flow).

The western boundary of the NMMA is a combination of the east-west R3 administrative line (San Luis Obispo County land use zoning) from the Cienega Valley to the coast and south along the coastline. Groundwater flow has historically occurred from land to the ocean across this boundary. This boundary is particularly important because a reversal of flow across this boundary may result in seawater intrusion.

Along the coastal portion of the NMMA, there is a potential for seawater intrusion to occur. The risk of seawater intrusion into NMMA water supply aquifers is a function of the groundwater elevation, the depth of the aquifers, the structural geology and stratigraphy, and the location of a seawater-fresh groundwater interface. It is not known if the aquifers are exposed on the seafloor along the coastal portion of the NMMA (PG&E, 2014). The nearest known aquifer exposure on the seafloor occurs to the north of the NMMA area. A further risk of seawater intrusion to NMMA water supply could exist along vertical migration pathways in a near coastal zone or lateral intrusion from the adjacent management areas. Seawater intrusion is minimized where offshore gradients exist, and could occur most rapidly if the onshore aquifers are pumped in excess of fresh water replenishment.

The southern boundary of the NMMA is at the base of the mesa along the Santa Maria River Valley. Groundwater flow across this boundary can occur and may be impeded by the Oceano fault. A cross section along this boundary has been developed to aid in characterization of the subsurface geology. Hydrogeologic parameters, if available, may then be used, along with groundwater level contour maps, to estimate the amount of flow that occurs at this interface between the NMMA and the SMVMA.

Groundwater from the shallow dune sand aquifer has been observed to discharge into the streams that follow the base of the mesa on the northwest, southeast and southwest, including: an irrigation drainage ditch in the Cienega Valley west of Halcyon Road, Nipomo Creek downstream of Nipomo, the base of the mesa from Nipomo Creek to Division Road, and Little Oso Flaco Creek west of Highway 1 (Althouse and Meade, 2012). Groundwater discharges as springs from the shallow dune sand aquifer, into drainages north of the Summit Station Road area, and along the southern slope of Nipomo Creek Valley.

Groundwater flow within the NMMA

Groundwater flow within the NMMA is influenced by geologic features, and recharge and discharge points. Laterally discontinuous aquitards within the NMMA restrict vertical groundwater flow particularly between the shallow and deep aquifers. Recharge sources include major point sources (Los Berros Creek, stormwater runoff basins, and wastewater percolation ponds) and distributed recharge sources (septic systems, percolation of rainfall, and irrigation return flows). Discharge locations include pumping wells, areas of springs and seeps, and phreatophyte consumption.

Previous geological studies identify multiple faults that transect the NMMA (Figure 2-1). The faults and the offset of beds could impede flow within basin sedimentary deposits. Recent investigations further explore the possibility that these faults could act as leaky barriers to groundwater flow (Fugro, 2015; Geoscience, 2018).

Aquitards that influence vertical migration of groundwater between aquifers can have varying thicknesses and hydraulic conductivities as demonstrated in the geologic cross-sections (Figure 2-2, Figure 2-3, Figure 2-4, Figure 2-5). A significant aquitard exists in some areas underneath the base of the Older Dune Sand formation that confines groundwater in underlying aquifers. Locally groundwater may be perched above the aquitard. Some leakage is likely to occur where the aquitard hydraulic conductivity increases and thickness decreases. The extent and thickness of the aquitards have been defined in some places based on well logs and correlations or inferred based on groundwater levels. Aquitard extent and variations in permeability are interpreted for the regional groundwater flow model, which includes the NMMA (Fugro, 2015; Geoscience, 2018).

Shallow aquifer groundwater elevation reflect unconfined conditions. As described previously, where shallow aquifer groundwater reaches the ground surface, groundwater discharges to springs and creeks. This drainage is observed within and adjacent to the NMMA, in Black Lake Canyon, Little Oso Flaco Creek, and in the nearby coastal dune lakes. The standing water in these surface water features reflects the groundwater elevation in the shallow aquifer. The water levels in these surface water features have been intermittently monitored and can be used to represent the shallow aquifer groundwater elevation if recent measurements are available. Perched groundwater occurs locally where fine-grained lenses occur within the shallow aquifer. Perching layers and relatively high groundwater elevation have been observed in the southeastern portion of the NMMA and in the northern portion of the NMMA, north of Halcyon Road.

Groundwater flow from the Los Berros Creek alluvium toward the NMMA can occur where the alluvium overlies or is in contact with the shallow and deep aquifers along the southern edge of the Los Berros Valley. Hydrogeologic parameters can then be used, along with groundwater levels, to estimate the amount of groundwater flow that occurs at Los Berros Valley alluvium and NMMA basin sediments interface. The TG is evaluating the alluvial valley aquifer and seasonal conditions.

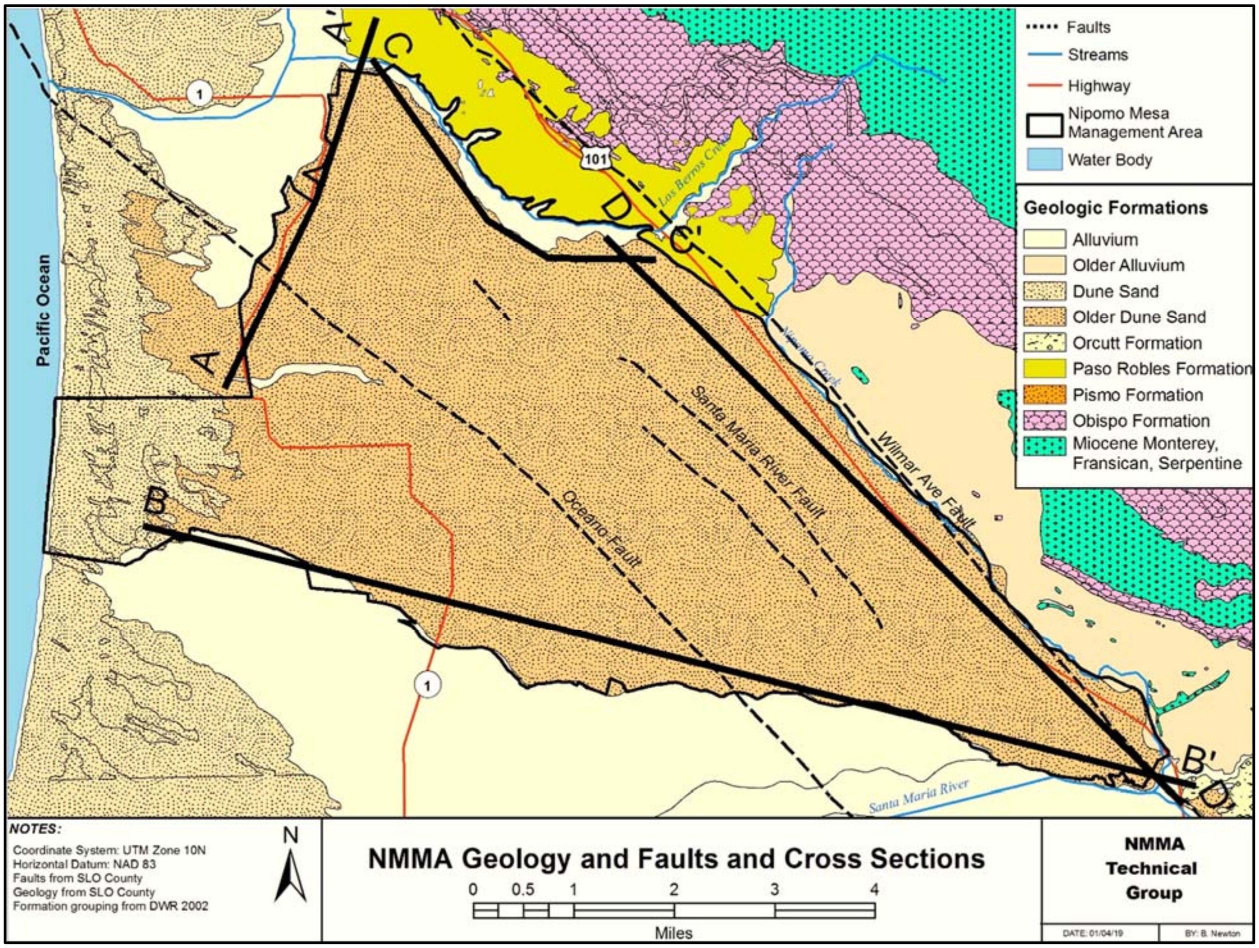

Figure 2-1. NMMA Geology and Faults and Cross Sections

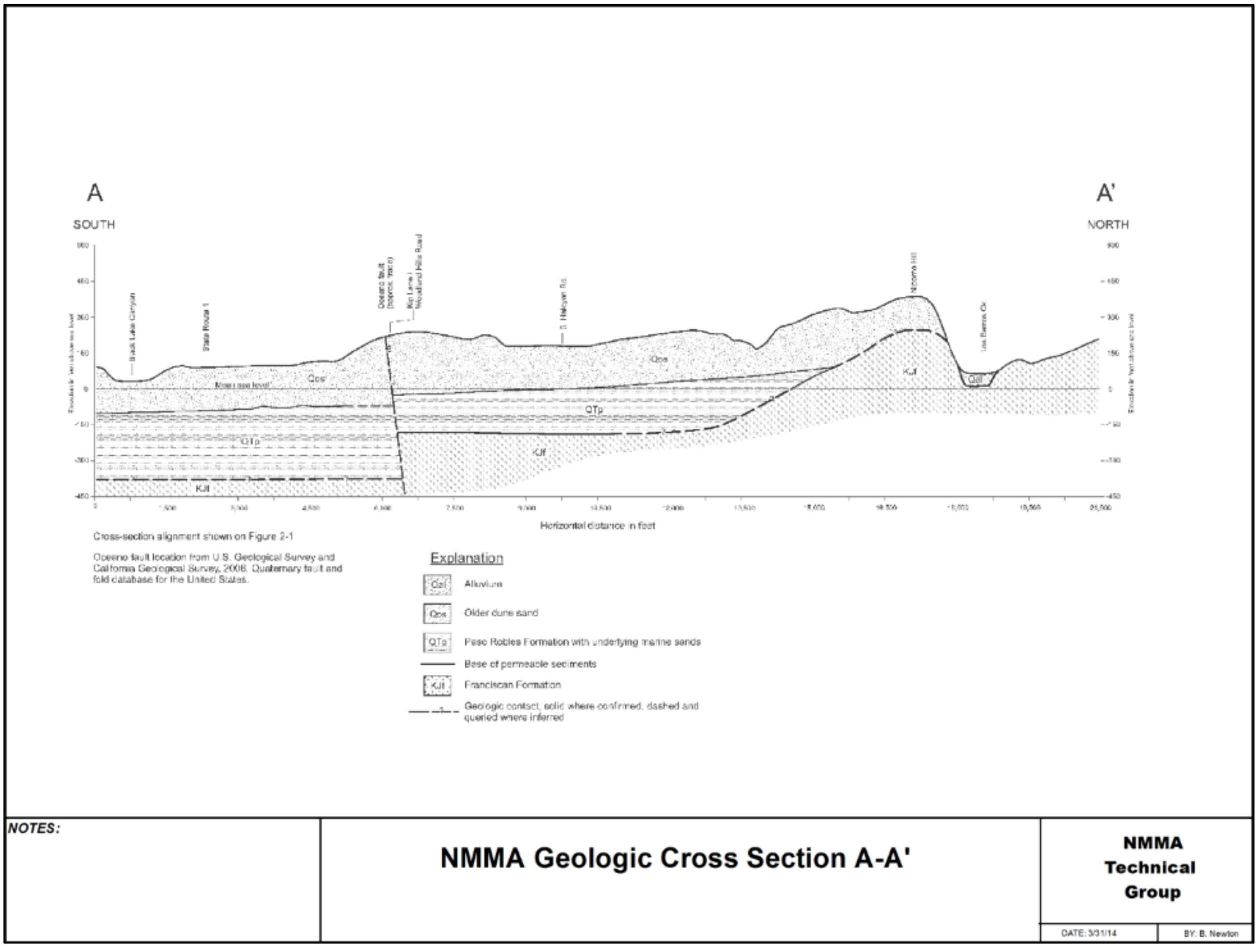

Figure 2-2. NMMA Geologic Cross Section A-A'

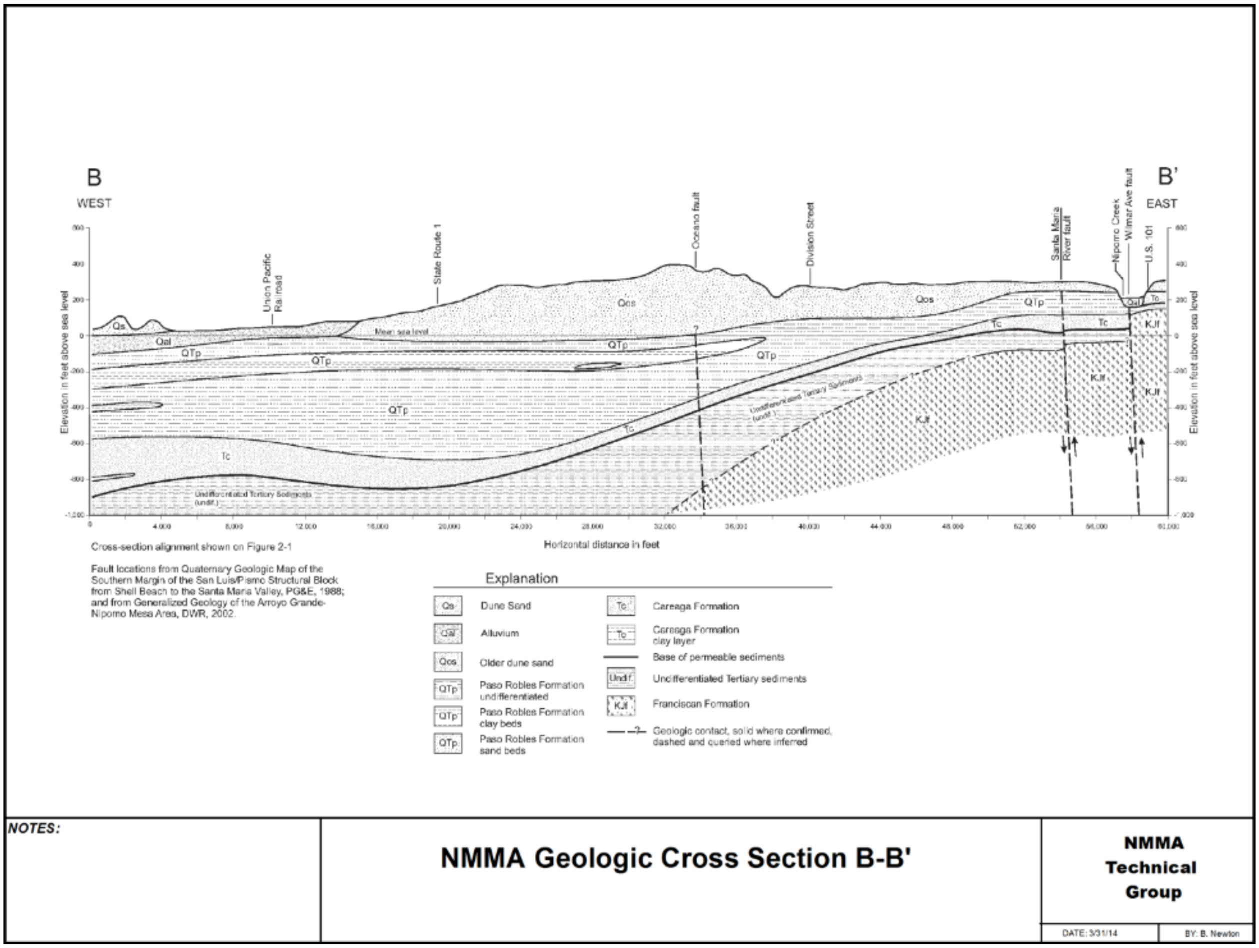

Figure 2-3. NMMA Geologic Cross Section B-B'

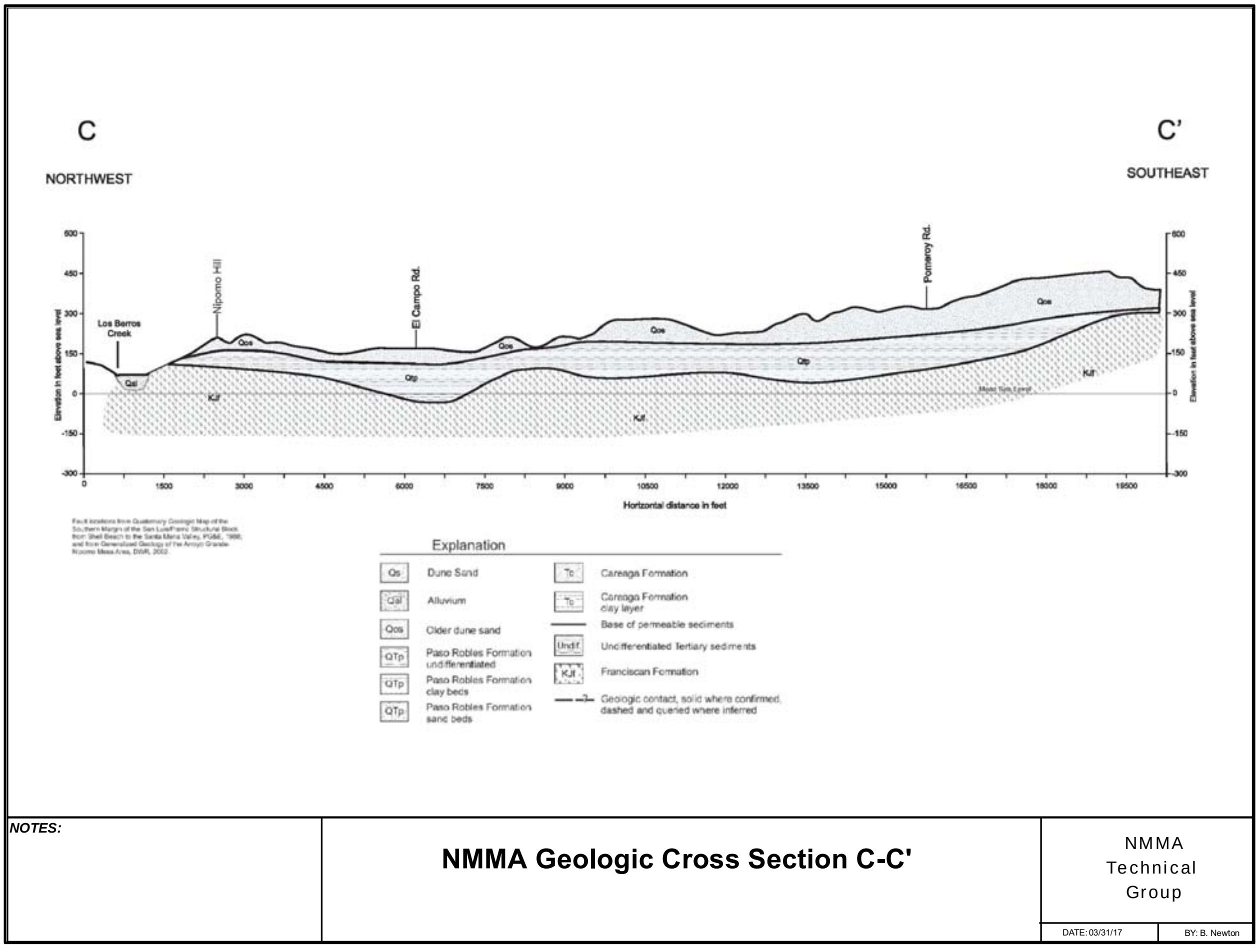

Figure 2-4. NMMA Geologic Cross Section C-C'

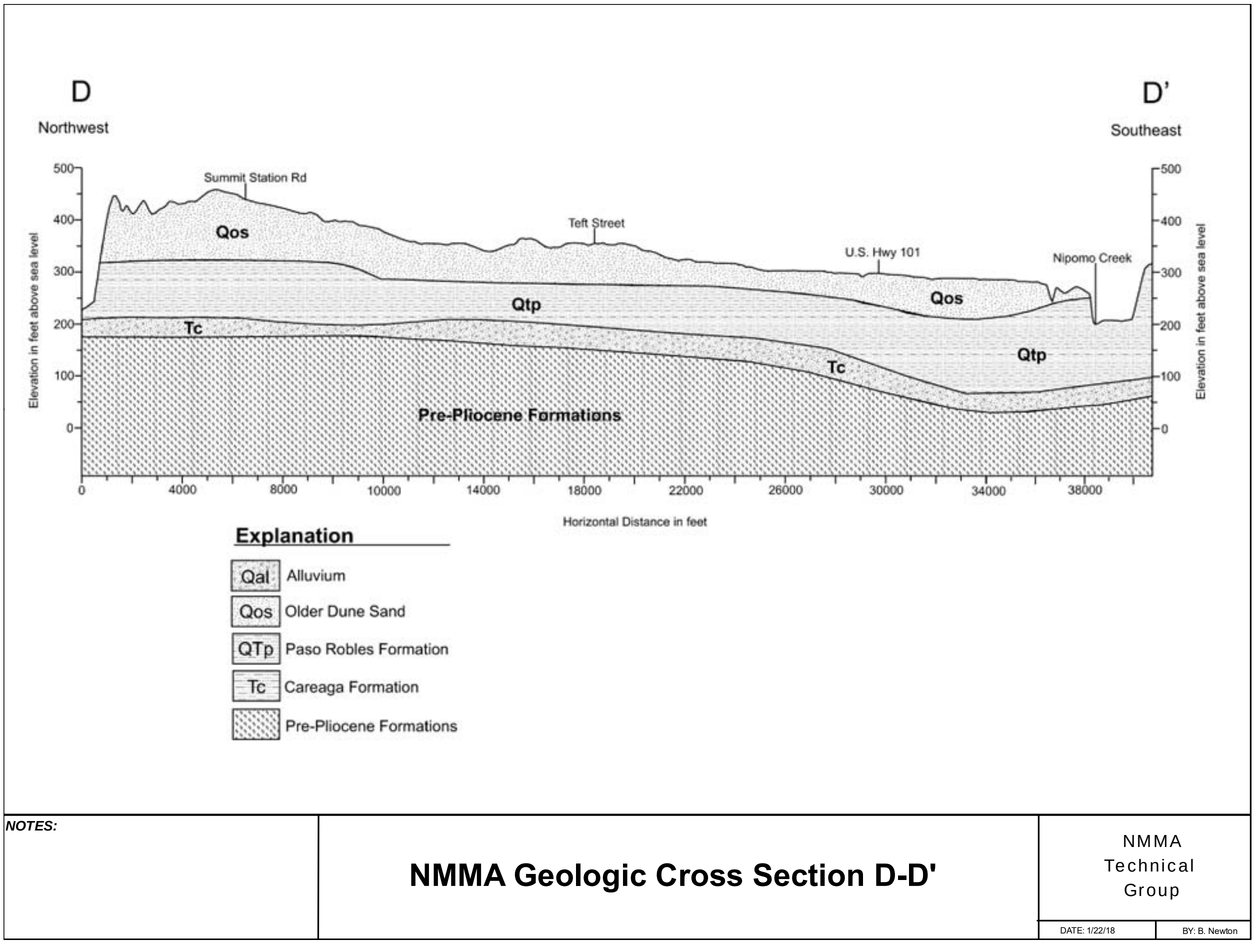

Figure 2-5. NMMA Geologic Cross Section D-D'

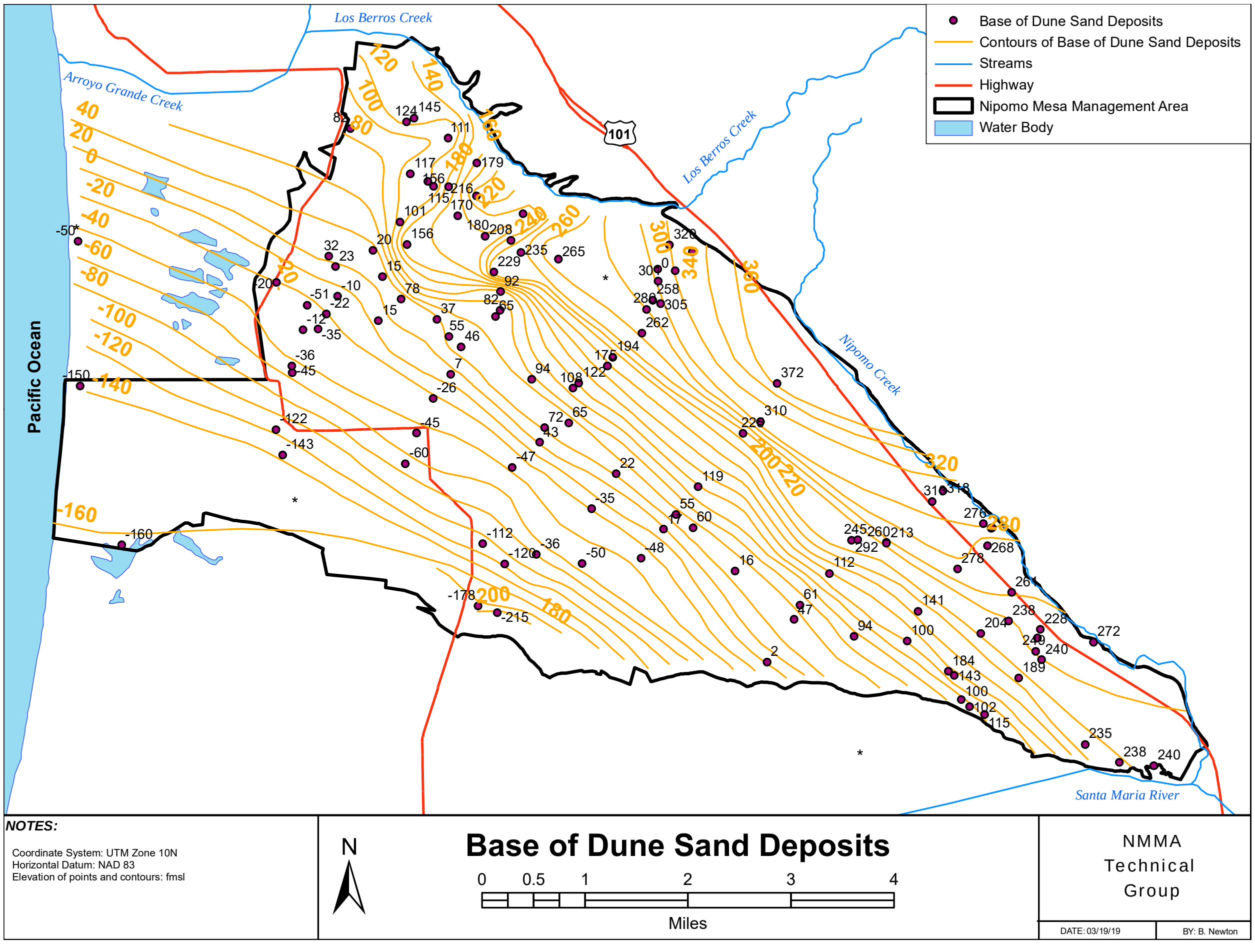

Figure 2-6. Base of Dune Sand Deposits

3. Data Collection

The TG is monitoring and analyzing water conditions in the NMMA in accordance with the requirements of the Stipulation and Judgment. The Stipulating Parties are required to provide monitoring and other production data at no charge, to the extent that such data are readily available. The TG has developed protocols concerning measuring devices in order to obtain consistency with the Monitoring Programs of other Management Areas. Discussions of these subjects are presented in the following subsections of this 13th Annual Report – Calendar Year 2020.

3.1. *Data Collected*

The data presented in this section of the Annual Report were measured during the calendar year (CY) 2020 and are the subject of this Annual Report. Groundwater elevations, water quality, rainfall, surface water, land use, groundwater production and wastewater discharge data were compiled and are presented in the following sections.

3.1.1. Groundwater Elevations in Wells

Groundwater elevation is determined by measuring the depth to water in a well from a reference point at the top of the well casing. The reference point and depth to water data are collected from each agency and input into a TG database that includes groundwater elevation determinations. The date, depth to water, measuring agency, pumping condition, and additional comments are recorded. When the database is updated with new data, an entry is posted in the database log describing the changes that have been made to the database. The groundwater elevation measurements are subjected to Quality Assurance Quality Control procedures adopted by the TG in part by reviewing historical hydrographs to determine if the measurements are within the historical range for the given well.

The accuracy of the groundwater elevations depends on measurement protocols, the reference point and local drawdown effects at that well. The TG surveyed the elevation for all the reference points at each Key Well in February of 2009. Additional elevation surveys for all monitoring program wells are scheduled for the continued improvement of groundwater elevations accuracy. Furthermore, protocol standards were developed by the TG regarding the length of time for well shut down before a groundwater elevation measurement is taken, and a notation of whether nearby wells are known to be concurrently pumping.

The management area engineers have compared construction, location, reference point elevation, and depth to water measurements for wells near their common boundary as an ongoing practice since the first annual report. In 2017, engineers from the TG and NCMA Monitoring Parties conducted a focused study to compare construction, location, reference point elevation, and depth to water measurements for wells near the boundary between the management areas to identify any inconsistencies. These differences within the management area engineers' databases were reconciled, and these conditions are reviewed each year. This process improves consistency between groundwater elevation contours across and close to the boundary shared by the NMMA and NCMA.

Depth-to-water measurements were collected in both shallow aquifers and deep aquifers in April and October of 2020 by the County of San Luis Obispo, NCSD, P66, Woodlands, GSWC; and, the Santa Maria Valley Water Conservation District collected depth-to-water measurements in CY 2020 (Figure 3-1, Figure 3-2, Figure 3-3, Figure 3-4).

3.1.2. Water Quality in Wells

Water quality of the NMMA during 2020 is summarized from a wide range of data sources, including:

- California State Water Resources Control Board Division of Water Quality records of water supply system groundwater sources and environmental monitoring sites (GeoTracker GAMA database),
- State Water Resources Control Board site assessments, remediation project reports, and related materials (GeoTracker database),
- NPDES Permit Monitoring and Reporting data, and
- Other NMMA groundwater monitoring data.

Data reported in this Annual Report are derived from samples obtained using standard professional sampling protocols and analyzed at certified laboratories. The TG maintains these data in a digital database. In the NMMA, historical data from approximately 200 wells can be used to map groundwater quality conditions. In some cases, water quality records consist of only one or two sampling events from a well, and only a few water quality parameters, such as total dissolved solids or chloride. In other cases, such as wells within potable water systems or for environmental testing, regular groundwater quality testing for a wide range of constituents is conducted.

Groundwater quality in wells near the ocean is of considerable importance because this is the most likely area where intrusion of seawater would first be detected. The coastal nested wells, 11N36W12C01, 12C02, and 12C03, are monitored under agreement with SLO PWD and allow quarterly water quality sampling of general mineral and physical water quality constituents, subject to access constraints for the protection of endangered species (Table 3-1). In addition to monitoring this coastal site for water quality, the TG has assessed the cost of updating coastal monitoring near the former nested wells 11N36W13K02 through 13K06 adjacent to Oso Flaco Lake and recommends replacement of these wells.

Table 3-1. 2020 Water Quality Data from Coastal Wells

Coastal Well	Date	Cl (mmoles/L)	HCO3 (mmoles/L)	Na (mmoles/L)	Ca (mmoles/L)	Mg (mmoles/L)	SO4 (mmoles/L)	B (mmoles/L)
11N36W12C01S	1/22/2020	1.32	3.8	3.13	2.99	1.73	3.95	0.018
	4/28/2020	1.24	3.8	3.52	3.74	2.18	4.37	0.019
	10/21/2020	1.38	3.8	3.74	3.24	1.89	3.95	0.020
11N36W12C02S	1/22/2020	1.46	3.8	3.39	3.49	2.10	5.10	0.019
	4/28/2020	1.46	3.8	3.17	3.24	1.93	5.20	0.019
	10/21/2020	1.35	3.8	3.61	3.74	2.22	4.79	0.018
11N36W12C03S	1/22/2020	2.68	5.1	3.78	2.24	1.52	2.39	0.026
	4/28/2020	not sampled	not sampled	not sampled	not sampled	not sampled	not sampled	not sampled
	10/21/2020	2.62	4.9	4.26	2.49	1.69	2.39	0.025
Seawater		544.9	2.38	467.5	10.4	53.3	28.1	0.41

Water quality data are collected from a variety of wells such as environmental monitoring wells that are screened in the unconfined shallow aquifers, and purveyor water supply wells of which many are completed in deep aquifers. Monitoring of shallow groundwater is conducted at a near-coastal industrial facility, in the vicinity of wastewater treatment facility discharges, and in NMMA areas where a shallow aquifer is separately utilized, and from wells that provide agricultural irrigation supply. In 2020, water quality data results were available from 65 water supply wells in addition to 16 monitoring wells and 17 environmental monitoring wells (Figure 3-5).

3.1.3. Rainfall

There are seven active rainfall gauges available to estimate the NMMA rainfall (Figure 3-6). Four gauges are part of the ALERT Storm Watch System: Nipomo East (728), Nipomo South (730), Los Berros (4620), and Oceano (795). One gauge is a California Irrigation Management Information System (CIMIS), CIMIS Nipomo (202). The other two gauges are active volunteer gauges and include Mehlschau (38), and Nipomo CDF (151.1). The data are collected by the SLO PWD and CIMIS. The TG obtains these data from CIMIS and SLO PWD at the beginning of the calendar year for the rainfall data from the preceding year. SLO PWD staff collects volunteer gauge data once each year in the month of July for the previous year, July through June. In CY 2020, the TG directly collected the remainder of the Nipomo CDF (151.1) data for July through December from the San Luis Obispo County Fire Department. Rainfall data are compiled on a water year and calendar year basis. A water year (WY) typically begins October 1st and ends September 30st of the following year, and the year referenced is that of September (i.e., WY 2003 is defined as October 1, 2002, through September 30, 2003). For the volunteer gauges, data collected from July 2020 to December 2020 are unavailable until July 2021, when County staff collects and compiles the rainfall data.

The WY 2020 rainfall total is 88 percent of the long-term average (Table 3-2, see Note 2). Reference evapotranspiration for WY 2020 is 48.63 inches, which is the same as WY 2019. Rainfall measurements made during CY 2020 range from 8.19 to 10.19 inches, and are approximately 60 percent of the average long-term annual rainfall.

Table 3-2. Rainfall Gauges and 2020 Rainfall Totals

Name	Period of Record	Period of Record Mean	Water Year 2020[1]	WY Percent of Mean[2]	Calendar Year 2020	CY Percent of Mean[2]
Nipomo East (728)	2005-2020	15.39	13.93	88%	9.32	60%
Nipomo South (730)	2005-2020	13.29	11.73	74%	8.19	52%
Oceano (795)	2005-2020	12.37	14.14	89%	10.04	64%
Los Berros (4620)	2014-2020	16.32	13.66	86%	9.49	61%
CIMIS Nipomo (202)	2006-2012	13.74	ND	ND	ND	ND
Nipomo CDF (151.1)	1958-2020	15.83	15.85	100%	10.19	65%
Mehlschau (38)[3]	1920-2020	16.58	14.81[3]	94%	8.18[3]	52%

Notes:

ND - Data reported is indicative of irrigation overspray with daily reported amounts ranging from 0.01 to 0.03 from spring into summer or data is not available.

1. Water Year is defined as Oct. 1 of previous year through Sept. 30 of the current year.
2. Percent of Normal, calculated using the period of record annual mean for gauge #151.1.
3. Volunteer gauge is collected in July of the year and therefore is missing the remaining months (July through December) of that year.

3.1.4. Rainfall Variability

Quantifying the temporal and spatial variability is critical where rainfall is a large portion of the water supply. Spatial variability in the volume of rainfall across the NMMA is apparent when comparing the WY 2020 rainfall totals from these gauges. The WY 2020 total rainfall ranged from 11.73 inches (Nipomo South #730) to 15.85 inches (Nipomo CDF #151.1). Temporal variability is also an important consideration, particularly between storms. Two storms with the same total rainfall can have a vastly different impacts to water supply, for instance, if one storm occurred over a week and the other occurred over a day.

Climatic trends and interannual variability also impact the water supply to the NMMA. The cumulative departure from the mean was prepared for two rain gauge stations, Mehlschau #38 and Nipomo CDF #151.1, over the period from WY 1975 to WY 2020 (Figure 3-7). Periods of wetter than average and drier than average conditions are coincident at both gauges. The most pronounced dry period occurred from 1983 to 1994, followed by a wetter than average period from 1994 to 1998. From 1998 to present, there have been several years of alternating wet and dry conditions. WY 2014 was the driest year since WY 1975, with six of the last eight years well below normal.

3.1.5. Streamflow

Currently, there are some records of streamflow near the NMMA boundary. There are three streamflow gauge on Los Berros Creek: the Los Berros #757 streamflow sensor is located 0.8 miles downstream from Adobe Creek and 3.7 miles north of Nipomo on Los Berros Road, the Valley Road

#731 streamflow sensor is located on at the Valley Road bridge over Los Berros Creek, and the Los Berros Creek #4660 streamflow sensor is located at Quailwood Lane bridge downstream of State Route 101. The stage data at the Los Berros gauges are compiled by SLO PWD. Nipomo Creek streamflow is not currently gauged. Cachuma Resource Conservation District and San Luis Resource Conservation District maintain the Oso Flaco #312OFC20 streamflow sensor located between the Oso Flaco Lakes on Oso Flaco Creek. Flow was observed during April and May 2020 at Los Berros Creek #4660 streamflow sensor, near the upstream edge of the NMMA. No flow was recorded at the Valley Road #731 streamflow sensor during 2020, a short distance downstream of the boundary of the NMMA (Figure 3-8).

3.1.6. Surface Water Usage

There are no known diversions of surface water within the NMMA.

3.1.7. Surface Water Quality

There are no surface water quality data presented in this annual report.

3.1.8. Land Use

Land use data historically have been collected for the NMMA by the DWR at approximately ten year intervals from 1959 to 1996. DWR periodically performs land use surveys of the Southern Central Coast area (which includes the NMMA). DWR has not updated the land use for the South Central Coast area (which includes the NMMA) since 1996.

The 2007 NMMA land use was classified by applying the DWR methodology to a June 2007 one-foot resolution aerial photograph. Land use was classified into four main categories based on the methodology used by DWR in 1996; agriculture, urban, golf course and native vegetation (undeveloped lands). Agricultural lands for 2009 were further subdivided using the San Luis Obispo County Agriculture Commissioner survey of the 2009 crop types and acreage for San Luis Obispo County. The major crops grown on in the NMMA are strawberries and cane berries, nursery plants, vegetable rotational, and avocados.

Urban lands were classified following the DWR methodology with additional sub categories based on San Luis Obispo County land use categories from land use zoning maps. The categories for urban include (1) Commercial-Industrial; (2) Commercial-office, (3) Residential Multi-family; (4) Residential-Single Family; (5) Residential-Suburban; (6) Residential-Rural; (7) Recreational grass; (8) Vacant. Golf courses were classified separately from Agricultural or Urban Lands.

Native vegetation lands were classified following the 1996 DWR methodology. In the DWR methodology, all undeveloped land was classified as native vegetation and includes groves of non-native eucalyptus and fields of non-native grasses. The lands classified as native vegetation were further broken down into two categories: grasses; and trees and shrubs; to better estimate deep percolation of rainfall required for the hydrologic inventory (see Section 5 Hydrologic Inventory).

The land use acreage was surveyed and updated in 2013 by performing aerial imagery analysis, observations made by NMMA TG engineer representatives, and assessing San Luis Obispo County pesticide purchase records. The update indicates that an increase in agriculture usage occurred from 2009 to 2013. The largest increase occurred in areas of the NMMA planted with strawberries and cane berries. The second largest increase in agriculture usage occurred in areas planted with vegetable rotational. In addition to agriculture, golf course acreage increased. In 2015, agricultural land use was updated to track the emerging cane berry crop and expanding strawberry acreage. In 2016, the golf course area irrigated was updated (Table 3-3). Some of the greenhouses and agricultural lands have been converted to grow cannabis. The square footage of greenhouse cannabis grows and the water use impacts of this conversion have yet to be determined. The 2016 SLO County Ordinance requires that all cannabis cultivation operations provide a detailed water management plan and that any water use shall be offset from a prior use at a 1:1 ratio and that under severe water decline shall be offset at least at a 2:1 ratio as documented in a County approved Water Conservation Program. The water use of these operations is to be reported to the County. In 2020, the agriculture and golf course land use acreages were surveyed and updated by performing aerial imagery analysis. This update includes a correction in golf course area, and modest increases in acreage for grape and deciduous, vegetable rotational, and berries while there was a commensurate decrease in recreational grass, pasture, and non-irrigated farmland.

The land use acreage for Urban is 10,596 acres; for Agriculture is 2,988 acres; and for Non Irrigated is 7,957 acres. Sub-categorical land use acreage is also defined and will subsequently be utilized to compute the groundwater production and consumptive use of water for each subcategory (Table 3-3).

Table 3-3. Land Use Summary

Land Use Category	Year of Data	Acreage
Urban		
Commercial – Industrial	2007	472
Commercial – Office	2007	118
Golf Course	2020	611
Residential Multi-family	2007	24
Residential Single Family	2007	821
Residential Suburban	2007	3,597
Residential Rural	2012	4,829
Recreational Grass	2020	124
Urban Total	**2020**	**10,596**
Agriculture		
Grape and Deciduous	2020	135
Pasture	2020	17
Vegetable Rotational	2020	425
Avocado and Lemon	2020	340
Berries	2020	1,621
Nursery	2020	366
Non-irrigated Farmland	2020	84
Agriculture Total	**2020**	**2,988**
Non Irrigated		
Native Vegetation	2018	7,232
Urban Vacant	2007	716
Water Surface	2007	9
Non Irrigated Total	**2018**	**7,957**
Total Land Use		**21,541**

3.1.9. Groundwater Production (Reported and Estimated)

The groundwater production data presented in this section of the Annual Report were collected for CY 2020. Where groundwater production records were unavailable, the groundwater production was estimated for CY 2020 (Figure 3-9).

Reported Groundwater Production

Individual landowners, public water purveyors, and industry all rely on groundwater pumping from the aquifers underlying the NMMA. Data were requested by the TG from the public water purveyors and individual pumpers and incorporated in this CY 2020 Annual Report. Stipulating Parties to the Judgment are required to provide monitoring and other production data at no charge, to the extent that such data have been generated and are readily available.

Monitoring Parties provided production records that report a total of 4,066 acre feet (AF) of groundwater produced from the principal production aquifers in CY 2020 (Table 3-4).

Table 3-4. Calendar Year 2020 Groundwater Production for Monitoring Parties

Monitoring Parties	Production (AFY)
NCSD	1,008
GSWC	1,332
Woodlands (less Golf Course, Vineyard, Landscape, and Construction)	626
P66	1,100
Total	**4,066**

Groundwater produced for golf course irrigation in CY 2020 was 1,392 AF. An estimated value of 36.5 inches of golf course irrigation was calculated based on the soil water balance model. The total amount of water applied to golf courses is the combination of groundwater and treated wastewater that is used for irrigation. Monarch Dunes reports a blending ratio of five parts groundwater to one part reclaimed wastewater for irrigation on 238 acres of golf course. Total estimated irrigation on Monarch Dunes is 449 AF in CY 2020, of which 217 AF is shallow aquifer groundwater production and 92 AF is reclaimed wastewater. The Woodlands provides sufficient reclaimed wastewater to meet the golf course irrigation blending ratio (see Section 3.1.11 Wastewater Discharge and Reuse). The Cypress Ridge golf covers 191 acres with a total estimated 571 AF of golf course irrigation in CY 2020, of which 552 AF is groundwater production and 19 AF is reclaimed wastewater. The Blacklake golf course covers 182 acres, with a total estimated amount of golf course irrigation of 544 AF in CY 2020, of which 502 AF is groundwater production and 42 AF is reclaimed wastewater.

Table 3-5. Calendar Year 2020 Groundwater Production for Golf Courses

Golf Course	Production (AFY)
Monarch Dunes	357
Cypress Ridge	533
Blacklake	502
Total	**1,392**

Estimated Production

The CY 2020 estimated groundwater production for irrigating agricultural crops in the NMMA is 7,176 AF, computed by a soil water balance model on a daily time-step by multiplying the crop area and the crop specific water demand met by either soil moisture, rainfall, or groundwater production, thus developing the unit production for CY 2020 (Table 3-6). Drip irrigation is the dominant mechanism for watering crops, and therefore, an irrigation efficiency parameter is deemed not necessary to estimate groundwater production for agriculture in the NMMA. Furthermore, daily time steps are critically important in this climate when relatively warm dry windy conditions persist during winter months and are only interrupted by storms that occur over a few days. The crop specific water demand was re-evaluated in conjunction with the 2015 Land Use update (see Section 3.1.8 Land Use). The change in crop coefficients used for this estimate is presented in an appendix to this Annual Report (see Appendix E). Berry crops continue to account for the largest portion (64% in 2020) of the total annual agricultural groundwater production (Table 3-6).

Table 3-6. Calendar Year 2020 Estimated Groundwater Production for Agriculture

Crop Type	2020 Area (Acres)	2020 Unit Production (AF/acre)	2020 Production (AFY)
Grape and Deciduous	135	0.8	111
Pasture	17	3.1	52
Vegetable Rotational	425	2.3	972
Avocado and Lemon	340	2.5	839
Berries	1,621	2.8	4,594
Nursery	366	1.6	608
Non-irrigated Farmland	84	0.0	0
Total	**2,988**		**7,176**

Groundwater production for urban use was estimated for other land uses including rural landowners not served by a purveyor. The estimated production for the other land uses is 1,679 AF for CY 2020 (Table 3-7).

Table 3-7. Calendar Year 2020 Estimated Groundwater Production for Other Land Uses

Land Use Type	Water Use Area (acres)	Unit Production (AF/acre)	Production (AFY)
451RS Zoned Parcels[1]	172	3.4	696
616 RR Zoned Parcels[1]	243	3.4	983
Total	**886**		**1,679**

Note:
1. Unit production values from NCSD 2007, Water and Sewer Master Plan Update scaled to measured drought conservation by purveyors.

Combining the estimates of groundwater production for Stipulating Parties (Table 3-4), for golf courses (Table 3-5), for agriculture (Table 3-6), and for other land uses (Table 3-7) results in an estimated total groundwater production of 14,313 AF for CY 2020 (Table 3-8).

Table 3-8. Calendar Year 2020 Measured and Estimated Groundwater Production (AFY)

Measured	
NCSD	1,008
GSWC	1,332
Woodlands	626
P66	1,100
Golf Course	1,392
Subtotal	**5,458**
Estimated	
Other Land Uses	1,679
Agriculture	7,176
Total NMMA Production	**14,313**

3.1.10. Imported Water

Nipomo Supplemental Water Project (NSWP) water is currently the only source of imported water delivered onto the NMMA. NSWP began delivering water to the NMMA on July 2, 2015 and continued to deliver water through December 31, 2020. A total of 1,041 AF of NSWP water was delivered during the CY 2020.

3.1.11. Wastewater Discharge and Reuse

Six wastewater treatment facilities (WWTF) discharge treated effluent within the NMMA. Four of the WWTFs are the Southland Wastewater Works (Southland WWTF), the Blacklake Reclamation Facility (Blacklake WWTF), Cypress Ridge Wastewater Treatment Facility (Cypress Ridge WWTF), and the Woodlands Mutual Water Company Wastewater Reclamation Facility (Woodlands WWTF) (Figure 3-10). The GSWC iron and manganese removal treatment facilities at La Serena and Osage groundwater production wells discharge treatment filter backwash to percolation ponds. The total wastewater discharge in the NMMA was 657 AF for CY 2020 (Table 3-9).

Table 3-9. 2020 Wastewater Volumes

WWTF	Influent (AFY)	Effluent (AFY)	Re-use
Southland	554	482(1)	Infiltration
Blacklake	51	42(1)	Irrigation
Cypress Ridge	53	31	Irrigation and Infiltration(3)
Woodlands	Not Reported	92	Irrigation
La Serena	Not Applicable	9(2)	Infiltration
Osage	Not Applicable	1(2)	Infiltration
Total		**657**	

Notes:

1. Effluent was estimated as the sum of Influent - Evaporation from Aeration Ponds - 10% of Influent to account for biosolid removal. For the Nipomo Mesa calendar year 2020, the annual evapotranspiration measured at CIMIS 232 gage is 48.36 inches and the rainfall measured at Gauge 151.1 gage is 10.19 inches (CIMIS, 2020 and SLO DPW, 2020). This results in a net evaporation from a pond of 38.17 inches in calendar year 2020.
2. GSWC's La Serena and Osage iron and manganese removal facilities treat water from GSWC's La Serena #1 and Osage #1 wells. Filter backwash water is discharged to percolation ponds, where it infiltrates into the groundwater basin and a negligible amount is lost to evaporation.
3. The amount of wastewater discharged from the WWTF includes process losses of 3% relative to the influent wastewater stream. Re-used effluent includes 19 AFY withdrawn from lined golf course ponds for irrigation, after evaporative losses from 6.3 acres of ponds, and 12 AFY discharged to an unlined infiltration basin, after minor evaporative losses (see footnote 1 for evaporation rate).

3.2. *Database Management*

The database of monitoring data is an entirely digital database and is maintained as a confidential document. The database is broken into seven tables or datasets: groundwater elevation, groundwater production, wastewater treatment, stream flow, groundwater quality, climate, and land use.

NCSD's technical representative is currently designated as the database steward and is responsible for maintaining and updating the digital files and for distributing any updated files to other members of the TG. A "change log" is maintained for each database. The date and nature of the change, along with any special features, considerations or implications for linked or related data are recorded in the change log. The Stipulation and Judgment require that absent a Court order or written consent, the confidentiality of well data from individual owners and operators is to be preserved.

3.3. *Data and Estimation Uncertainties*

Uncertainties exist in data, and therefore uncertainties exist in derivatives of data, including interpretations and estimations made from direct measurements. Uncertainties arise from errors in measurements, missing measurements, and inaccurate methodologies and generalizing assumptions. For example, rainfall is measured at a few locations across the NMMA. However, it is well known that the spatial and temporal variability in rainfall deposition in a storm is much greater than that which the density of rainfall gauges can represent. Ground surface elevation across the NMMA is known to be in error at places and may be reported incorrectly by amounts as large as 20 feet. This affects the accuracy of groundwater elevations and contours. There exists missing data from both groundwater elevations and rainfall records. Estimations are made to fill in these data gaps with the understanding that the accuracy of these estimates is reduced. Derivatives from these data therefore contain inaccuracies. Additionally, precision issues arise when interpretations are made from data, in that individuals make decisions during the process of interpreting data that are subjective and therefore not documentable. For example, aerial image classification is a subjective process as is the preparation of groundwater elevation contours. Estimations are made for parameters, such as crop coefficients, that are not measurable or very difficult to measure. The methodologies used to make estimates represent a simplified numerical representation of the environment and are based on assumptions defining these simplifications. Quantifying the uncertainty in data or data derivatives is a rigorous and ongoing process.

The measured groundwater production values are reliable and are considered precise to the tens place for NCSD, GSWC, and Woodlands, and the hundreds place for P66. The estimated production values are less reliable and precise for the rural residence groundwater production. The unit production factors used to estimate the rural residence groundwater production were developed for the NCSD Water and Sewer Master Plan. For the estimated agricultural production, there are no measured data available in the NMMA to verify the precision or reliability of the agricultural production.

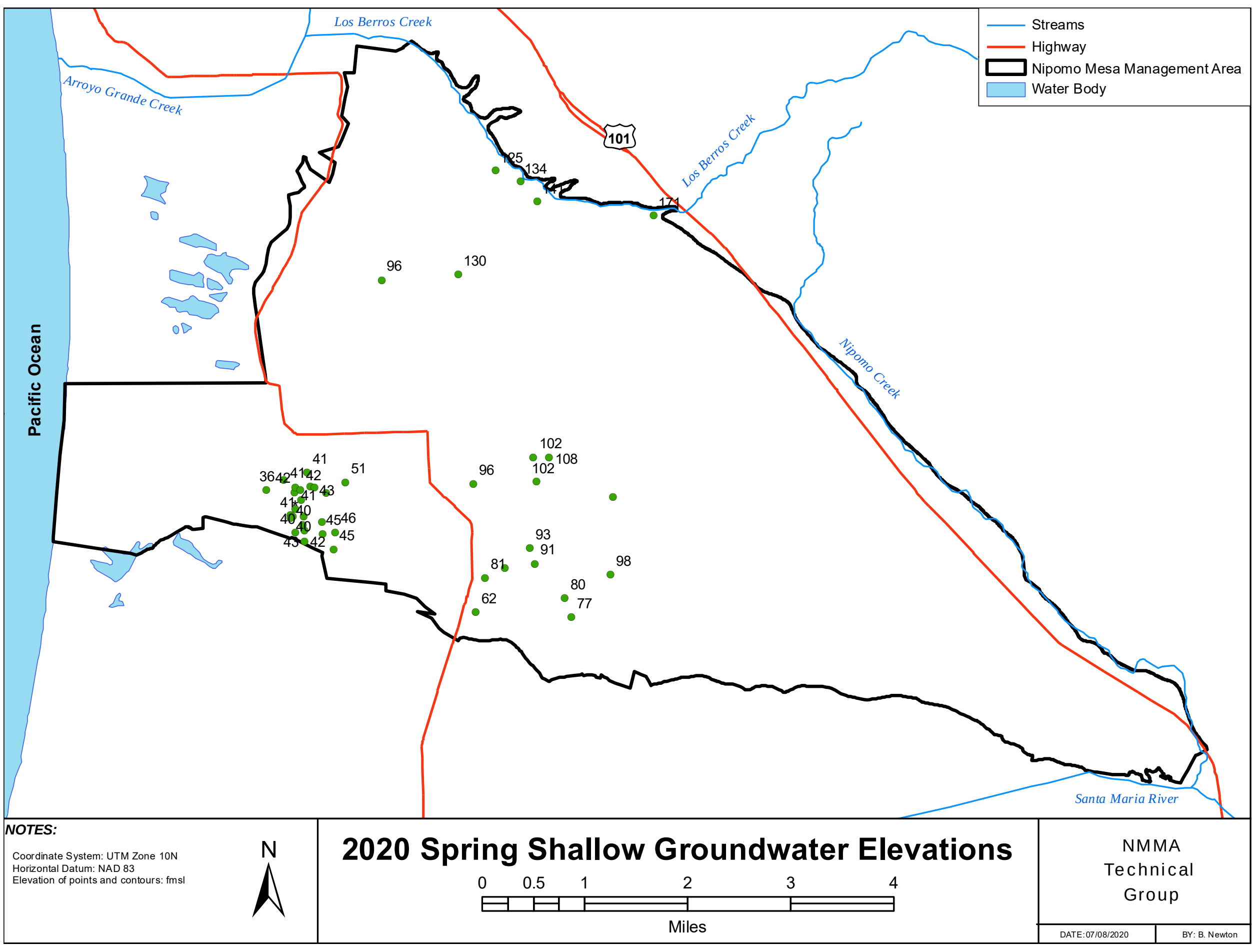

Figure 3-1. 2020 Spring Shallow Aquifer Groundwater Elevations

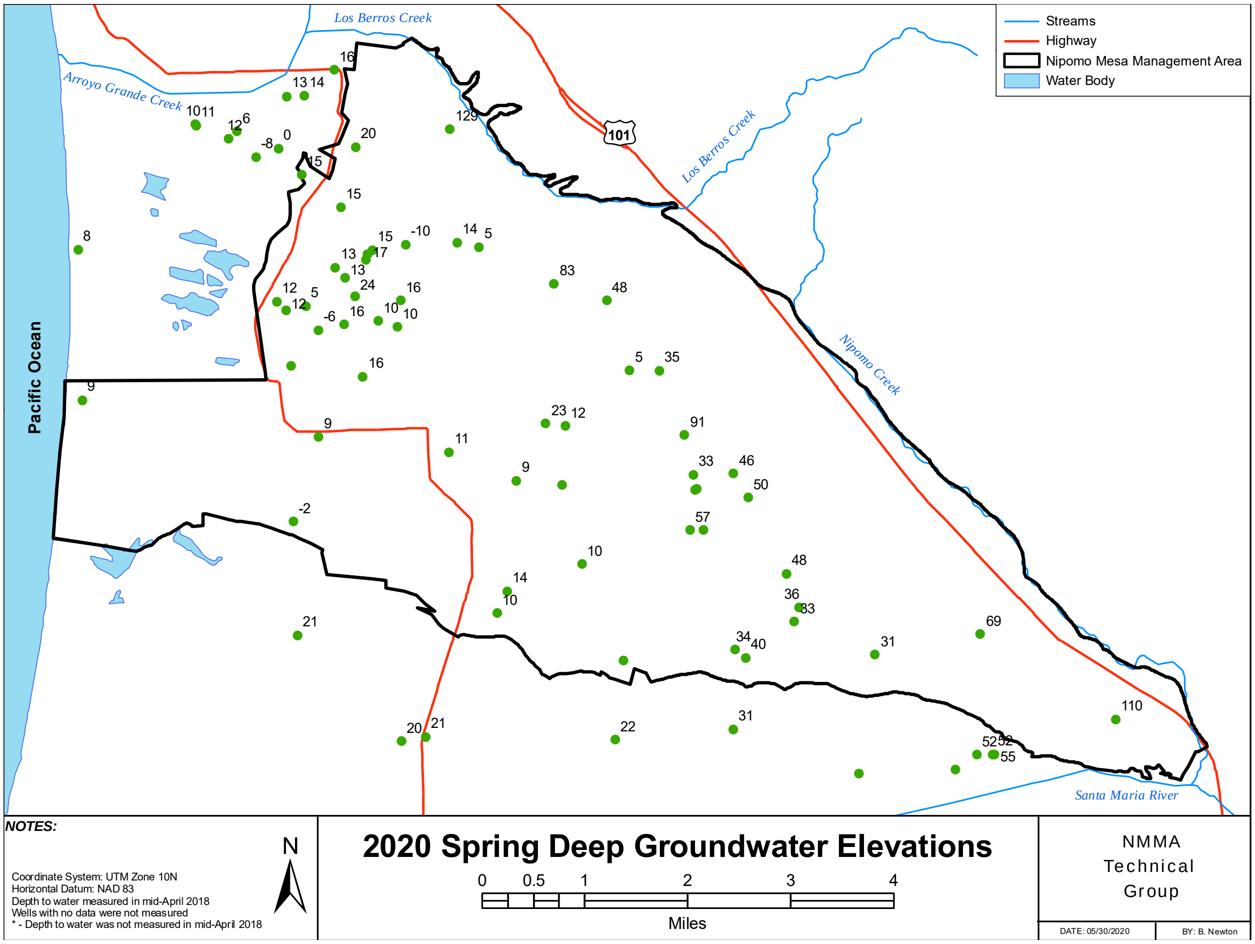

Figure 3-2. 2020 Spring Deep Aquifer Groundwater Elevations

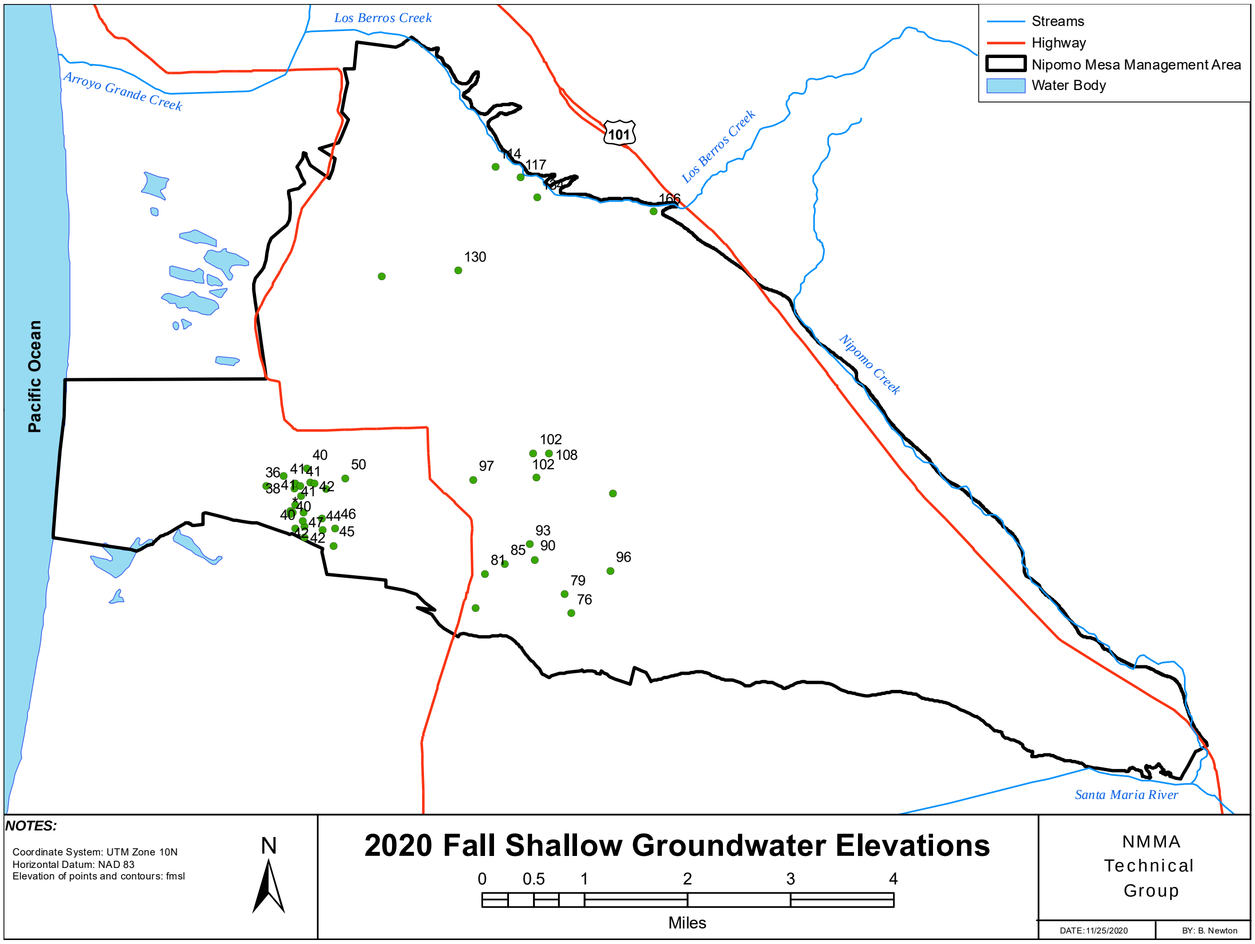

Figure 3-3. 2020 Fall Shallow Aquifer Groundwater Elevations

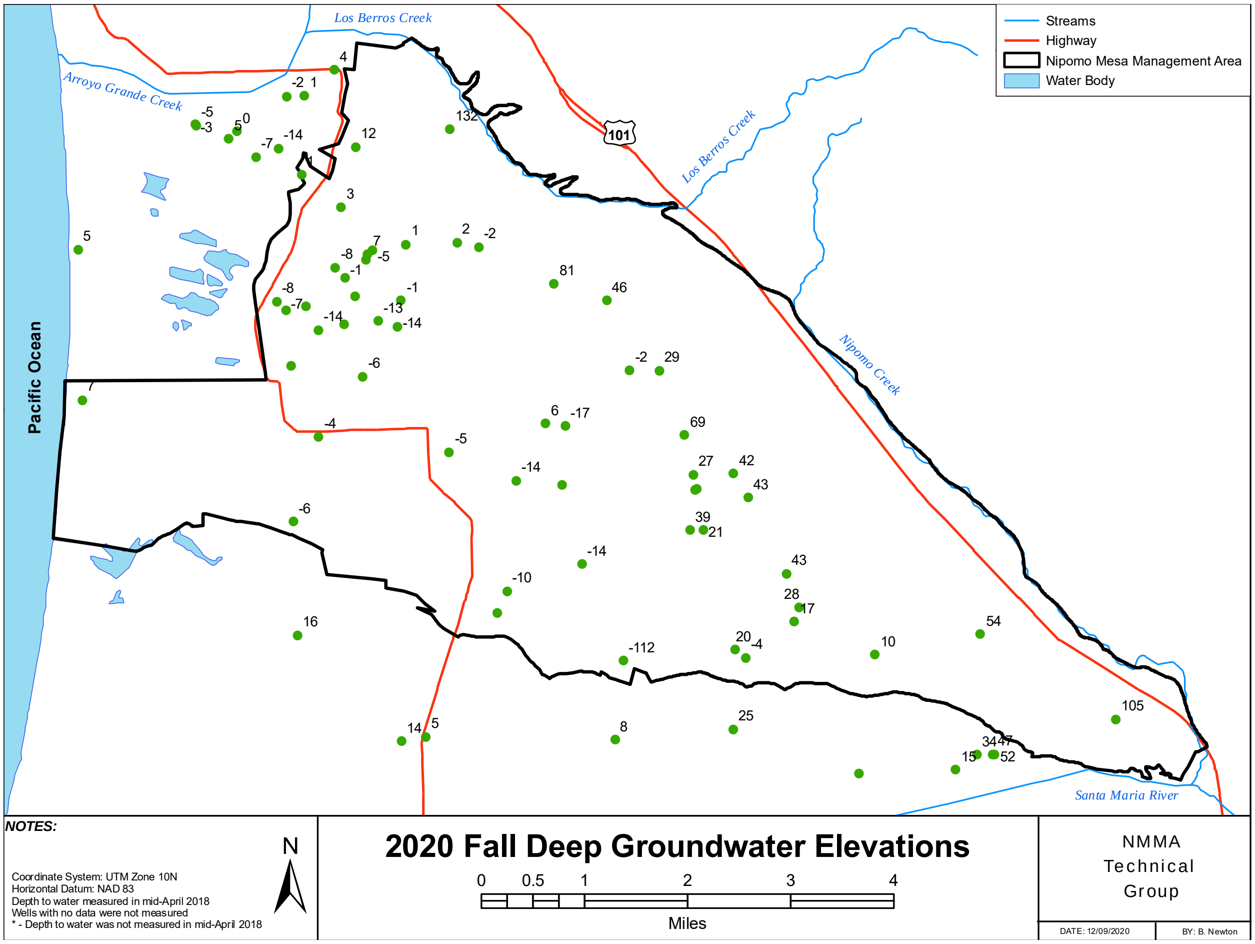

Figure 3-4. 2020 Fall Deep Aquifer Groundwater Elevations

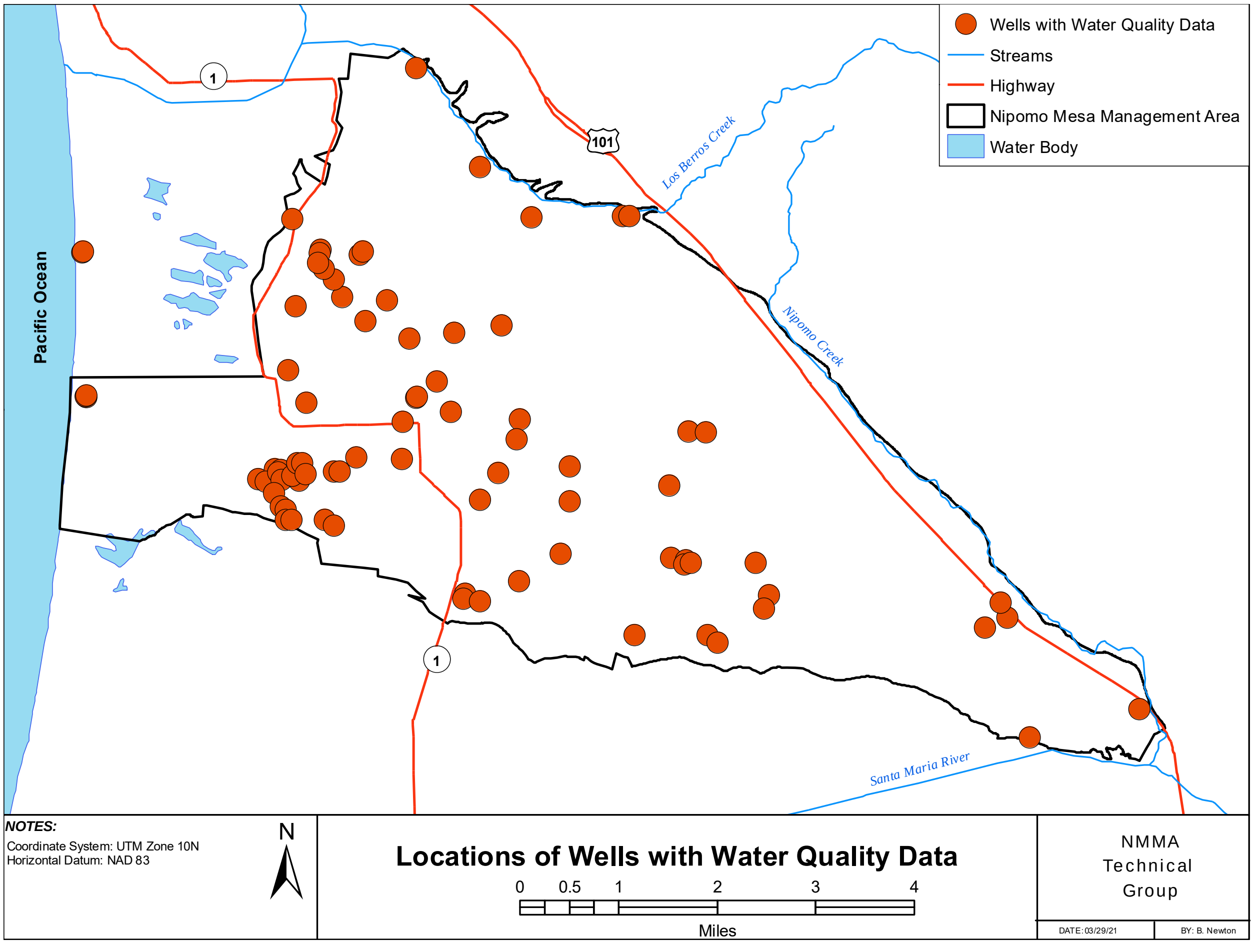

Figure 3-5. 2020 Locations of Wells with Water Quality Data

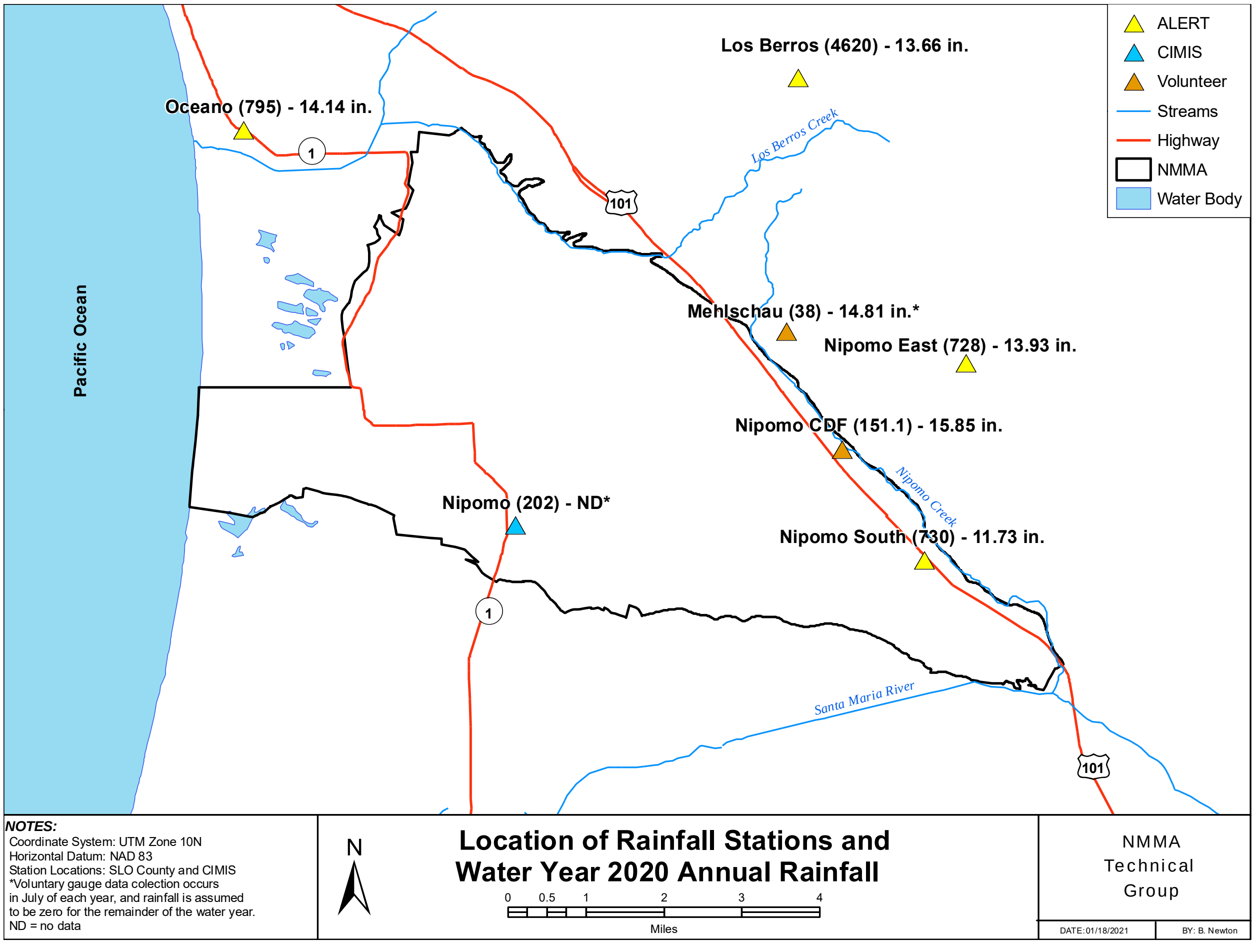

Figure 3-6. Rainfall Station Location and Water Year 2020 Annual Rainfall

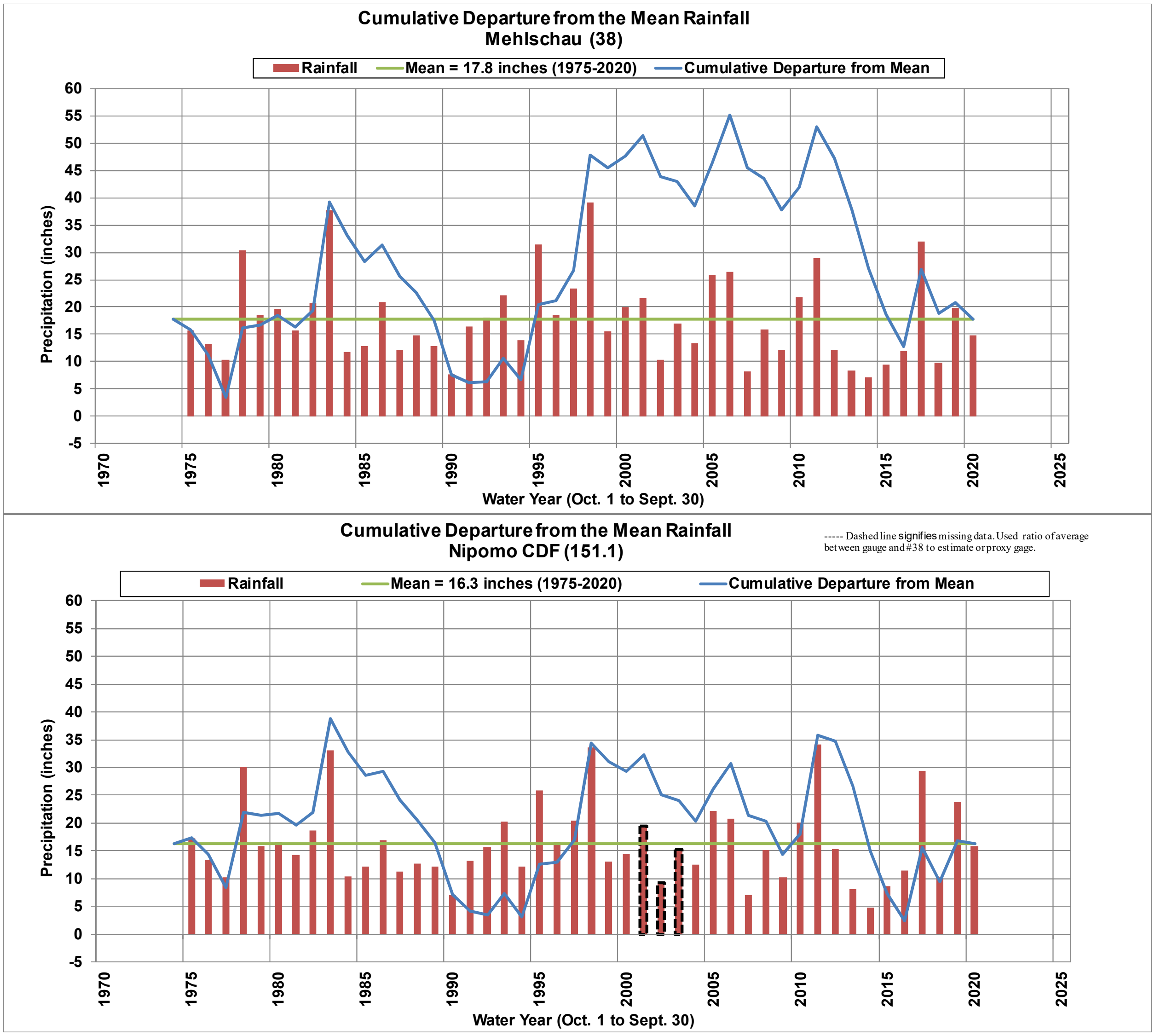

Figure 3-7. Cumulative Departure from the Mean for the following rain gauges: Mehlschau (38) and Nipomo CDF (151.1)

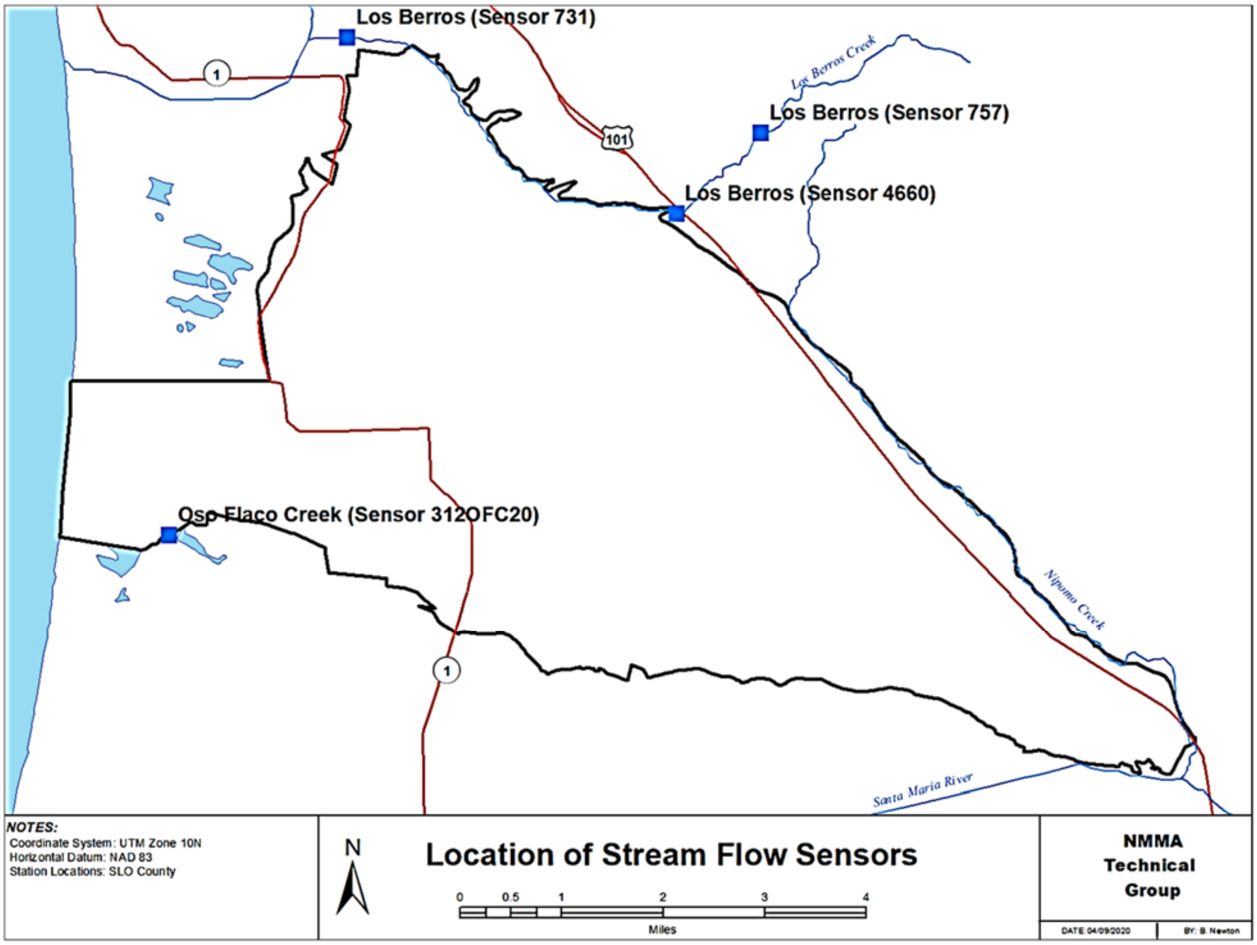

Figure 3-8. Location of Stream Flow Sensors

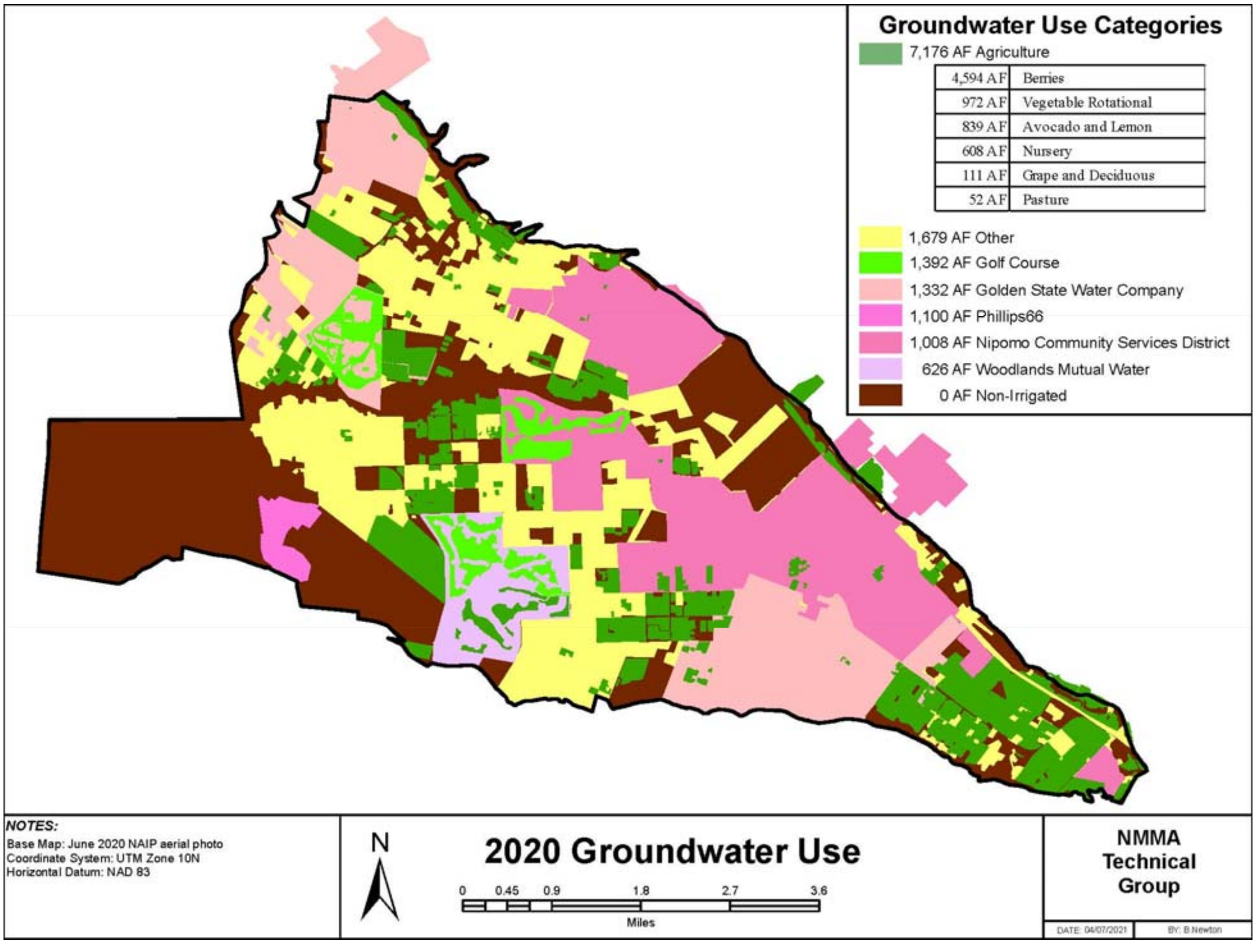

Figure 3-9. 2020 Groundwater Use

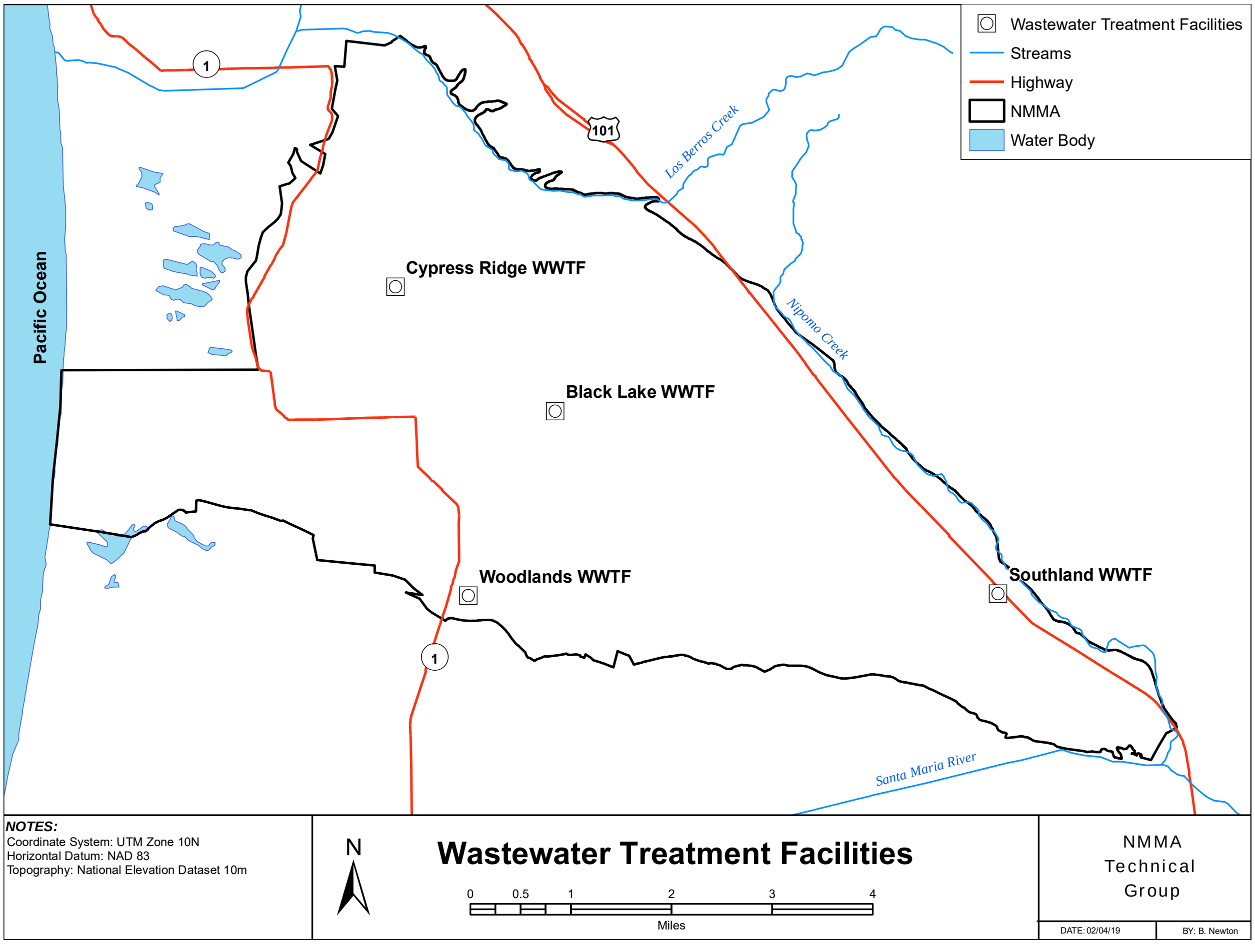

Figure 3-10. Wastewater Treatment Facilities

4. Water Supply & Demand

Presented in this section are discussions of the various components of current and projected estimates of water supplies and demands for the NMMA.

4.1. *Water Supply*

The water supplies supporting activities within the NMMA are met primarily from groundwater production with a minor amount of recycled water. No surface water diversions exist. Supplemental Water, as defined by the Stipulation, has been developed and Phase I deliveries began on July 2, 2015. A brief description of the groundwater production, recycled water, Supplemental Water, and surface water diversion is presented in the following sections.

4.1.1. Groundwater Production

Groundwater pumping was not differentiated between various strata, shallow or deep aquifers in previous annual reports. The specifics of shallow and deep aquifer production are better known by the

TG for purveyor wells which, at least through 2016, produce primarily from the deep aquifers, but this information is not available for many more private wells in the NMMA.

Shallow Aquifers

Domestic production by rural landowners was estimated to be about 1,679 AFY (Table 3-7). The majority of this production may be from shallow aquifers. A portion of the estimated 1,392 AF of golf course pumping may be from shallow aquifers (Table 3-5). A portion of the estimated 7,176 AF of agricultural pumping may also be from shallow aquifers (Table 3-6). The Woodlands shallow aquifer irrigation wells produced an estimated 217 AF for vineyard irrigation, buffer landscape, and construction in CY 2020 (Table 3-4).

Deep Aquifers

Production from wells used for public drinking water and industrial water is predominantly pumped from the deep aquifers (primarily the Paso Robles Formation), although some limited amount of production may also occur from shallow aquifers. This pumping is estimated to be about 4,066 AF (Table 3-4). In addition, a portion of the estimated 1,392 AF of golf course pumping by Cypress Ridge and Blacklake Golf Courses may also be from the deep aquifers (Table 3-5). Also, a portion of the estimated 7,176 AF of agricultural pumping may also be from the deep aquifers (Table 3-6).

4.1.2. Recycled Water

Wastewater effluent from the golf course developments at Blacklake Village, Cypress Ridge, and Woodlands is recycled and utilized for golf course irrigation. The amount of recycled water used in CY 2020 for irrigation at Blacklake Village, Cypress Ridge and Woodlands are 42 AF, 31 AF, and 92 AF, respectively (see Section 3.1.9 Groundwater Production (Reported and Estimated)and Table 3-9).

4.1.3. Supplemental Water

Nipomo Supplemental Water Project delivered 1,041 AF of water to the NMMA in CY 2020 (see Section 3.1.10 Imported Water).

4.1.4. Surface Water Diversions

There are no known surface water diversions within the NMMA.

4.1.5. Future Water Supply

The Stipulation (VI.E.5.) states all new urban uses shall provide a source of supplemental water to offset the water demand associated with the development. Currently, the only source of supplemental water dedicated to new urban uses is the 500 AFY of capacity NCSD added to the NSWP. Woodlands level of participation in the NSWP is considered their projected build out demand.

NCSD has committed to holding approval of new (since the date of the Judgment) water connections to the 500 AFY of capacity unless and until the District defines and acquires additional sources of supplemental water.

In September 2015, the County of San Luis Obispo adopted Ordinance 3307 which allows new urban development within the NMMA without imposing a requirement that the development project offset its water demand with a source of supplemental water. Instead, Ordinance 3307 requires the project proponent to offset the estimated new water demand of the project through some form of demand offset approved by the County (e.g., plumbing retrofit or participation in a County approved conservation program). By not requiring a source of supplemental water to offset project demand, this new County development approval process allows new groundwater uses for new development projects potentially inconsistent with the provisions in the Stipulation applicable to the NMMA water purveyors. The development approval process applied through Ordinance 3307 is concerning as it may allow for increased groundwater production within the NMMA, contrary to the groundwater management efforts of the NMMA water purveyors and TG.

4.2. ***Water Demand***

The water demands in the NMMA include urban (residential, commercial, industrial), golf course, and agricultural demands. The TG used a variety of methods to estimate the water demands of the respective categories (see Section 3.1.9 Groundwater Production).

4.2.1. Historical Demand

The historical data from 1975 to 2008 were compiled from available information. The TG has continued the historical data compilation with information from Annual Reports for 2008 to present. The historical demand estimated for urban (including golf course and industrial) and agricultural land uses has been steadily increasing since 1975, with urban accounting for the largest increase in total volume and percentage (Figure 4-1).

4.2.2. Current Demand

The estimated demand is 14,313 AF for CY 2020, based on annual groundwater production records provided by the water purveyors on the Nipomo Mesa, estimated groundwater production by land use area, and recycled water use (see Section 3.1.9 Groundwater Production (Reported and Estimated) and Section 3.1.11Wastewater Discharge and Reuse). This amount of demand represents a decrease from the previous year due to above average rainfall, correspondingly reduced irrigation, and an increase in imported water through the NSWP.

4.2.3. Potential Future Production (Demand)

The projected future demand for NCSD is an increase from 2,293 AFY in CY 2010 to 3,400 AFY in 2030 (NCSD, 2011 see Table 21 and 23). The P66 refinery expects future production to be similar to recent years' production amounts of approximately 1,100 AFY. The projected water demand for Woodlands at build-out, according to the Woodlands Specific Plan Environmental Impact Report, is 1,600 AFY (SLO, 1998). The projected water demand for GSWC at full build-out of the current Nipomo system service area is estimated to potentially increase to approximately 1,940 AFY in 2030 (GSWC, 2008). Currently, no estimates of potential future production for agriculture or GSWC's Cypress Ridge system service area have been developed.

4.2.4. Base Year Pooled Amount

The Stipulation (VI.D.2.b.i) requires the determination of the highest pooled amount of groundwater production previously collectively used in a year by Overlying Owners other than Woodlands and P66. The quantification of the highest pooled amount pursuant to this subsection shall be determined at the time the mandatory action trigger point (Severe Water Shortage Conditions) described in Paragraph VI(D)(2) is reached. The TG developed a technically responsible and consistent method to determine the pooled amount and any individual's contribution to the pooled amount. That method is as follows: identify those parcels that are included in the Stipulation and Judgment dated January 25, 2008 and that are located within the NMMA boundary and are not located within the service areas of the NCSD, GSWC, Woodlands, and P66. For each of such parcels, the highest pooled amount of groundwater production will be ascertained in any given year that yields the highest volume of production. This quantity for each parcel shall be determined either by the parcel owner's records of metered wells or, if the wells are unmetered, by an estimate of the production based upon other records that may be available, such as utility records. In the absence of utility records or any other reliable resource, this quantity shall be estimated based upon established industry data consistent with the sum of Agricultural demand and Rural Housing demand as presented in the Annual Report. The Stipulation (VI.A.5) conditions the enforcement of a reduction in their current use of Groundwater to no more than 110% of that highest pooled amount, upon the full implementation of the Nipomo Supplemental Water Project, including the Yearly use of at least 2,500 acre-feet of Nipomo Supplemental Water (subject to the provisions of Paragraph VI(A)(2)) within the NMMA. The method of reducing pooled production to 110% is to be prescribed by the TG and approved by the Court.

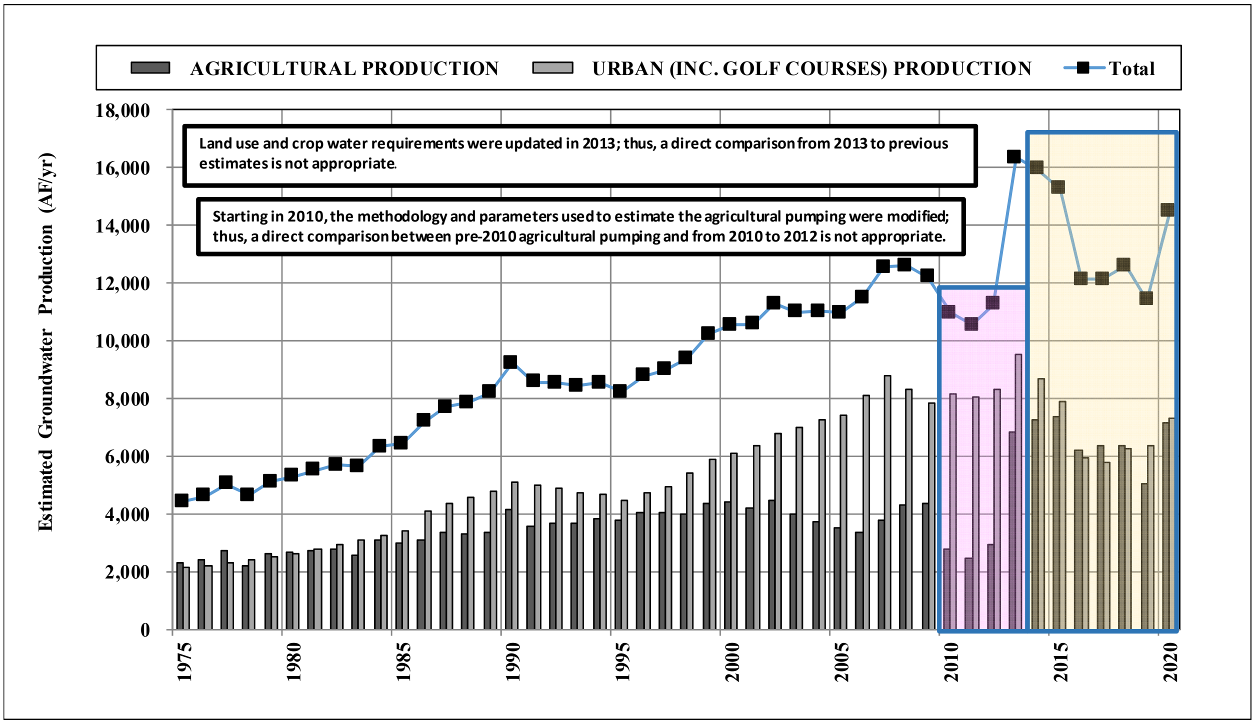

Figure 4-1. Historical NMMA Groundwater Production

5. Hydrologic Inventory

The hydrologic inventory accounts for the volumes of water that flow in to and out of the aquifers in the NMMA resulting in the change in storage. A conceptual schematic depicts the inflows and outflows to the aquifers underlying the NMMA (Figure 5-1). The hydrologic inventory can be formalized in the following equation:

$$\text{Change in Storage } (\Delta S) = \text{Inflow} - \text{Outflow}.$$

The components of the 2020 hydrologic inventory are presented and discussed in the following sections. The primary sources of inflow are groundwater (i.e., subsurface flow across the boundaries of the NMMA) inflow, rainfall, wastewater, and return flow. The primary outflows are groundwater production and groundwater outflow. Supplemental Water is also discussed as a potential future source of inflow.

5.1. *Rainfall and Percolation Past Root Zone*

Rainfall measurements made during CY 2020 range from 8.19 to 10.19 inches. The CY 2020 rainfall is 60 percent of the average long-term annual rainfall (Table 3-2, see Note 2). Rainfall on the NMMA infiltrates the soil surface and is either stored in the soil profile until it is evaporated or transpired by overlying vegetation, or percolates downward into shallow or deep aquifers. Rainfall on hardscape surfaces flows to local depressions where infiltration occurs. Locally rainfall may generate runoff from the NMMA to places adjacent to the NMMA boundary; however, the amount of runoff out of the NMMA is negligible. The TG estimates that the portion of rainfall that percolates past the root zone was 3,002 AF in CY 2020 (see Appendices E).

5.2. *Subsurface Flow*

Subsurface flow is the volume of water that flows into and out of the NMMA groundwater system. Typical methods used to estimate subsurface flow include Darcy's equation (using hydraulic conductivity, groundwater gradient, and aquifer thickness) or flow equations that are part of a regional groundwater model. In the NMMA, the three areas with the most potential for subsurface flow are at the northwestern boundary with the NCMA, the southern boundary with the SMVMA, and the seaward edge of the basin. Contours of groundwater elevations within the deep aquifer in this report (see Section 6.1.4 Groundwater Gradients) suggest that there is both flow in to and out of the boundaries of the NMMA with other management areas and along the coast. Groundwater elevation contours for the shallow dune sand aquifer suggest that there is a component of flow to the SMVMA.

The nature and extent of the confining layer(s) beneath the NMMA and the extent to which faults in the NMMA may act as impediments to subsurface flow are not well understood. The TG has not yet quantified the subsurface flows for CY 2020. However, the TG has developed hydrogeologic cross-sections along the NMMA boundary (see Section 2.3.1 Geology) sufficient to make estimates of subsurface flow (see Section 9 Recommendations).

5.3. *Streamflow and Surface Runoff*

Streamflow and surface runoff are the volumes of water that flow into and out of the NMMA through surface water channels or as overland flow. Streamflow includes water within the Los Berros Creek, Nipomo Creek, Oso Flaco Creek, and Black Lake Creek (Figure 5-2). Surface runoff occurs during major rainfall events and could occur in locations where local conditions near the NMMA boundary are sufficient to promote overland flow out of the area, and where shallow subsurface flow contributes to streamflow that is conveyed out of the NMMA, or to coastal dune lakes where it evaporates. This may occur in the following areas (Figure 5-2):

- Los Berros Creek streamflow into and out of the NMMA,
- Nipomo Creek streamflow into and out of NMMA,
- Black Lake Canyon streamflow out of the NMMA,
- Oso Flaco Creek streamflow into and out of NMMA,

- Surface runoff from steep bluffs adjacent to Arroyo Grande Valley, and
- Surface runoff from steep bluffs adjacent to Santa Maria River Valley.

The volume of streamflow which enters and leaves the NMMA is only partially understood. The TG continues to analyze where it might be appropriate for SLO County to install temporary or permanent stream sensor sites to determine the volume of water that percolates beneath streams in the NMMA (see Section 3.1.5 Streamflow).

5.4. *Groundwater Production*

The groundwater production component of the Hydrologic Inventory is calculated using metered production records where available and estimated from land use data where measurements are unavailable. The CY 2020 groundwater production is approximately 14,313 AF (Table 3-8).

5.5. *Supplemental Water*

Supplemental Water is the volume of water produced outside the NMMA and delivered to the NMMA through the NSWP. Supplemental water was delivered to the NMMA in CY 2020. The total amount of Supplemental Water delivered during the CY 2020 was 1,041 AF.

5.6. *Wastewater*

Wastewater discharges include wastewater effluent discharged by the six wastewater treatment facilities located within the NMMA, and ocean discharge of treated wastewater from the P66 industrial facility. In addition, discharges are estimated for septic tanks where centralized sewer service is not provided. The WWTFs include the Southland WWTF, the Blacklake WWTF, the Cypress Ridge WWTF, the Woodlands WWTF, and La Serena and Osage (GSWC). The Southland WWTF discharges treated wastewater into infiltration basins (see Section 3.1.11 Wastewater Discharge and Reuse). A portion of the water percolates and returns to the groundwater system and the remaining portion evaporates. The estimated percolation from Southland WWTF is 482 AF. GSWC delivered 741 AF of groundwater to their Nipomo system customers, where a small number of customers are connected to the Southland WWTF. The amount of groundwater produced that was delivered to customers connected to the Southland WWTF was 112 AF in CY 2020. The remaining GSWC Nipomo system customers discharged an estimated 277 AF of wastewater to septic systems. GSWC's La Serena and Osage iron and manganese removal treatment facilities treat water from GSWC's La Serena and Osage wells. Filter backwash water is discharged to percolation ponds, where water infiltrates into the basin. La Serena discharged 9 AF and Osage discharged 1 AF. The total WWTF effluent to infiltration basins in the NMMA was 504 AF (Table 3-9). The treated effluent from Blacklake WWTF (42 AF), Cypress Ridge WWTF (31 AF), and Woodlands WWTF (92 AF) is used to irrigate golf course landscaping. The estimated amount of wastewater discharge from indoor use by rural residences is 183 AF. The wastewater discharged in septic systems percolates downward and may recharge the shallow aquifers, the deep aquifers, or become shallow subsurface flow outside the NMMA.

5.7. *Return Flow of Applied Water and Consumptive Use*

Return flow is defined as the amount of recharge to the aquifers resulting from applied water that percolates past the root zone to recharge the aquifer(s). This functional definition differs somewhat from that used in the Stipulation to apportion the right to use water that was imported to the basin. However, the physical process of recharge by return flow of applied water is the same regardless of where the water originated.

The TG currently assumes that, all groundwater produced for outdoor use is attributable to sustaining plant life and replenishing soil profile storage, and that only rainfall generates percolation. Rural residences produced 203 AF of groundwater for indoor use in CY 2020. The estimated amount of return flow in CY 2020 from indoor use by rural residences is 183 AF, which is 90 percent of the 203 AF estimated indoor water use of rural residents plus the 250 AF of estimated return flow from indoor water use of GSWC's Nipomo system. There is no return flow from P66's groundwater production. The estimated total return flow from applied water, which includes 433 AF from indoor use and 504 AF from infiltration at WWTPs, is 937 AF in CY 2020.

The estimated consumptive use of water in the NMMA, computed by subtracting the total return flow (937 AF) from the groundwater production (14,313 AF), is 13,376 AF in CY 2020.

5.8. *Change in Groundwater Storage*

The change in groundwater storage from the hydrologic inventory reflects the difference between inflow and outflow for a period of time. Typically, this change in storage is compared to a change in storage computed from groundwater contours, cross-checking the results of each. Storage changes from groundwater contours are typically calculated by measuring change in groundwater elevation and multiplying that change by a storage factor (i.e., the specific yield of aquifer sediments), and the aquifer area. The TG's current understanding of conditions within the NMMA precludes calculating change in groundwater storage from groundwater contours at this time for the management area.

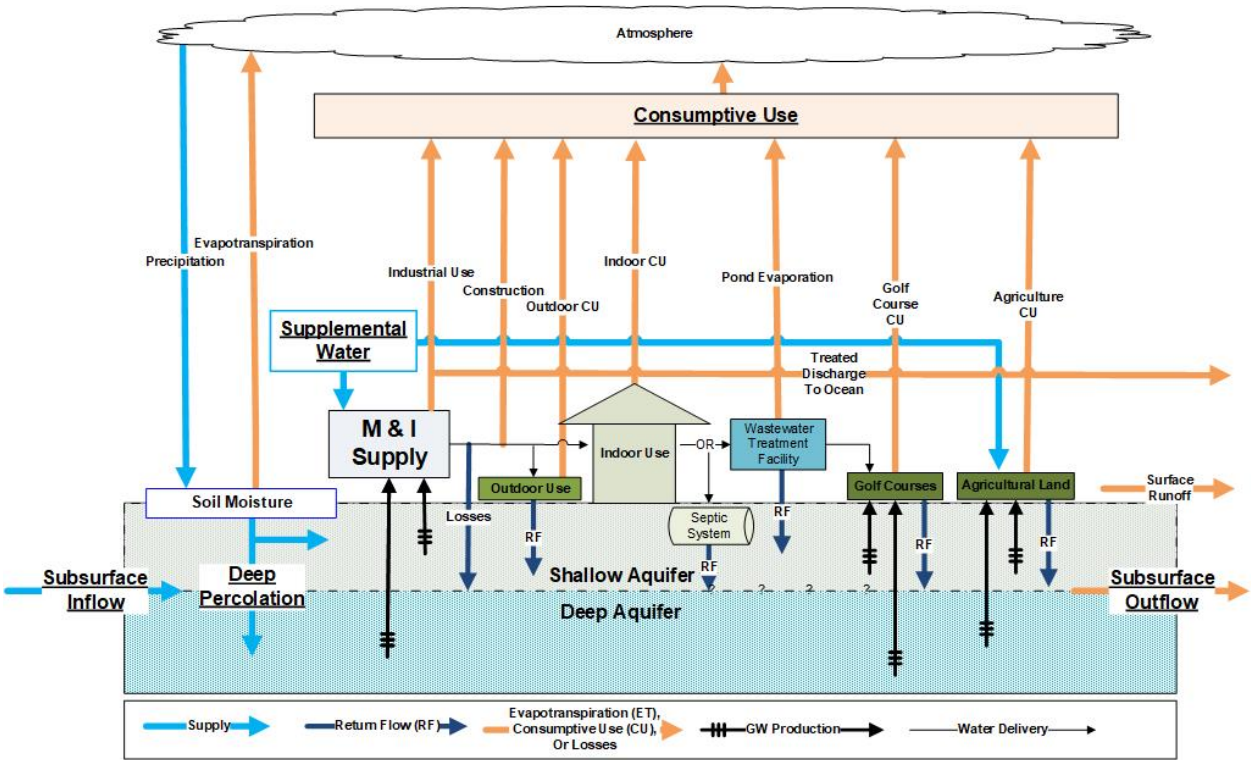

Figure 5-1. Schematic of the Hydrologic Inventory

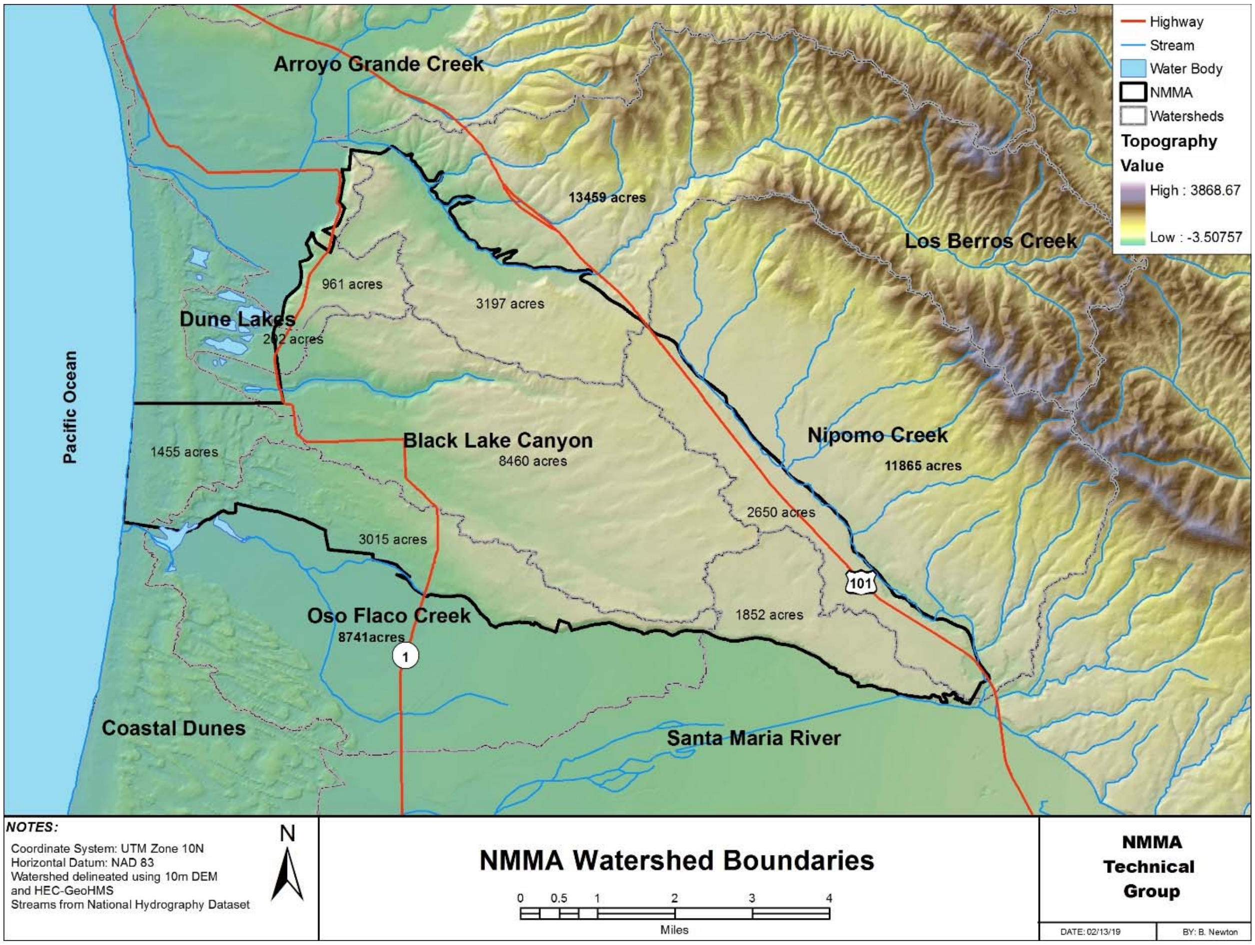

Figure 5-2. NMMA Watershed Boundaries

6. Groundwater Conditions

Groundwater conditions are primarily characterized by measurements of groundwater elevations and groundwater quality, and interpretations such as groundwater elevation contours, groundwater gradients, and historical trends in groundwater elevations and water quality.

6.1. *Groundwater Elevations*

Groundwater elevations are analyzed using several methods. Hydrographs (graphs of groundwater elevation through time) for wells within and adjacent to the NMMA were updated through CY 2020. Hydrographs were constructed for a number of wells, including the wells used to calculate the Key Wells Index and both sets of coastal monitoring wells. The key wells are combined to produce the Key Wells Index which represents groundwater levels beneath the NMMA as a whole (see Appendix B and Section 7.2.1). In coastal monitoring wells, groundwater elevations were graphed for each well completion within a nested site to compare to sea level. Finally, the aggregate of groundwater elevation measurements was used to construct groundwater contour maps for the Spring and Fall of 2020.

6.1.1. Results from Key Wells

Individual hydrographs were prepared for the key wells (Figure 6-1, Figure 6-2). These eight wells are used to calculate the Key Wells Index. Following a below normal precipitation year in 2020, groundwater elevations decreased from 2019 elevations in most key wells.

6.1.2. Results from Coastal Monitoring Wells

The elevation of groundwater in the coastal monitoring wells is very important because it is required to determine whether there is an onshore or offshore gradient to the ocean. Groundwater elevations in the nested coastal wells 12C and 36L were very similar in 2020 as compared to 2019 for coastal well 12C, and somewhat lower for coastal well 36L (Figure 6-3, Figure 6-4).

6.1.3. Groundwater Contours and Pumping Depressions

Groundwater elevation data representing water levels were plotted on separate maps for Spring and Fall of 2020 and contoured by hand. Groundwater elevation contours were constructed for both Spring and Fall of 2020 so that seasonal high and low groundwater elevation conditions could be analyzed (Figure 6-5, Figure 6-6, Figure 6-7, Figure 6-8).

There is limited information from publicly accessible wells that are screened in the shallow aquifers in the northern portion of the NMMA. Therefore, in that area, water levels from shallow wells are provided but were not contoured. Surface water elevations of the dune lakes within and immediately adjacent to the NMMA, that may be in hydraulic connection with shallow aquifers (dune sands and alluvial deposits), could also be useful in contouring of the shallow aquifer groundwater elevation. There is no formal monitoring of the dune lake water levels at this time and therefore were not used in the contouring of the shallow dune sand aquifer groundwater level. The base of the dune sand deposits rises in elevation toward the east within the NMMA (Figure 2-6). As the sloping base of the dune sands deposits approaches the relatively flat groundwater table, the saturated thickness decreases accordingly such that local areas of dune sand deposits are unsaturated. Therefore, shallow aquifer groundwater elevations from wells screened in the dune sand deposits have not been contoured in the northern and eastern NMMA, between the Wilmar Avenue fault and the northwestern projection of the Santa Maria River fault zone trend (Figure 2-1).

Spring 2020 shallow aquifer groundwater elevations in the southwestern portion of the NMMA reflect groundwater flow to the west. Groundwater elevations for select wells illustrate that spring to fall water level fluctuations are typically less than a few feet and there is a relatively stable long-term trend since 2008. Recharge to this shallow aquifer from surface is reflected in slowly rising water levels in some monitoring wells, although there is little difference in groundwater elevation in the shallow aquifer between 2019 and 2020.

Spring 2020 deep aquifer groundwater elevations are generally unchanged compared with Spring 2019, with areas of both higher and lower groundwater elevations. Fall 2020 deep aquifer groundwater elevations are generally lower compared with Fall 2019. The pumping depression within the inland portion of the NMMA continues to be expressed in both Spring and Fall 2020 deep aquifer groundwater elevation contours (Figure 6-6, Figure 6-8).

Deep aquifer groundwater contours along the eastern portion of the NMMA are sub-parallel to the eastern NMMA boundary indicating flow southwest into the NMMA. Recharge from rainfall and seepage from adjacent older sediments along and to the east of the NMMA boundary may be contributing to the southwest flow in the NMMA. Additionally, the Los Berros Creek bed is comprised of shallow alluvium and is in places in contact with the Paso Robles formation. This suggests the Los Berros Creek may be a source of local recharge along the northern boundary of the NMMA.

6.1.4. Groundwater Gradients

Groundwater gradient direction and magnitude can be calculated directly from the groundwater elevation contour maps; however, numerical computations are not presented here because local structural and stratigraphic controls on the NMMA groundwater flow regime are not sufficiently understood. The discussion of gradients is separated into coastal groundwater gradients that could affect potential seawater intrusion and gradients to and from adjacent management areas.

Coastal Gradients

Shallow dune sand aquifer groundwater contours in both Spring and Fall 2020 show a seaward gradient in the western NMMA. Deep aquifer groundwater contours in Spring 2020 show a landward gradient in the northwestern portion of the NMMA. There is only a small difference in deep aquifer groundwater elevations parallel to the coastline between the coastal plain of the NCMA, the coastal portion of the NMMA, and the pumping depression in the central portion of the NMMA. In Fall 2020, there continues to be a deep aquifer groundwater gradient that is landward from the coast, toward a broad area of the inland pumping depression which is below sea level.

The deep aquifer groundwater divide that historically separated the coastal area from inland areas was a transient feature formed because of the inland pumping depression. Although deep aquifer groundwater elevations at the southern coastal monitoring wells are above those defined for water shortage conditions, having such a landward gradient from coastal to inland increases the potential for seawater intrusion. This condition is not prudent for the long-term and will continue to be monitored carefully.

Gradients between Adjacent Management Areas

The shallow aquifer groundwater gradient along the southern boundary of the NMMA indicates flow to the southwest toward the boundary with the SMVMA and toward the ocean (Figure 6-5, Figure 6-7). The deep aquifer groundwater elevation contours between the NMMA and the NCMA indicate that the gradient between the management areas remains relatively flat in both Spring and Fall 2020. The deep aquifer groundwater gradient along the southern boundary of the NMMA indicates flow in to and out of the NMMA boundary with the SMVMA (Figure 6-6, Figure 6-8).

6.2. ***Groundwater Quality***

Water quality is a concern for all groundwater producers, although the specific concerns vary by water use. Water quality is somewhat different in different portions of the NMMA because:

- the source of recharge varies for different portions of the aquifer system,
- groundwater can develop different mineral signatures from the rock it flows through, and
- percolation of surface water can mobilize constituents of concern and carry these into the aquifers.

Water quality conditions in the NMMA during CY 2020 exhibit much of the same variability as observed in prior years. The following sections describe coastal water quality and inland water quality conditions.

6.2.1. Results of Coastal Groundwater Quality Monitoring

There is no evidence of seawater intrusion based on coastal groundwater quality. Quarterly coastal groundwater quality monitoring within the NMMA boundary is currently conducted at the nested wells site 11N36W12C01, 12C02, and 12C03, but the TG is also aware of published data for coastal groundwater quality conditions in the NCMA, at nested wells site 12N36W36L01 and 36L02. Limited historical groundwater quality data are also available for other coastal monitoring wells south of the NMMA near Oso Flaco, and from other coastal monitoring sites north of the 36L well. Chloride concentrations in the coastal wells are less than 100 mg/L, and do not show evidence of significant change over time (Figure 6-9). Coastal water quality monitoring at 11N36W12C01, 12C02, and 12C03 in 2020 also shows consistent results with respect to other common water quality characteristics such as total dissolved solids and electrical conductivity (Figure 6-10). Values for these constituents confirm relatively high dissolved ion content in groundwater, but at historically consistent values that are mostly within limits for existing uses.

Starting in 2018, the TG expanded the suite of ions analyzed that can be indicators of seawater intrusion. A series of charts display historical concentrations of major ions in groundwater from the coastal monitoring wells (Figure 6-11 through Figure 6-20). Two types of charts are included: major ion ratios compared to typical seawater (Figures 6-11 through 6-15), and time series of major ions (Figure 6-16 through 6-20). The purpose of presenting these data is to help document any significant changes in NMMA coastal groundwater chemistry. Major ion concentrations as well as ratios of different ions can be used to help determine if salinization of an aquifer is occurring and, if so, whether the source is seawater, sediments, or other factors.

There are no trends or changes in recent years that would suggest the onset of any contamination by a saline water source or seawater. Together with the historical chloride and electrical conductivity data, ion ratios of groundwater sampled in the coastal monitoring wells show that there are currently no ionic indicators of seawater intrusion.

6.2.2. Results of Inland Groundwater Quality Monitoring

In general, water quality of groundwater from NMMA wells is suitable for its existing uses and meets US EPA requirements for those intended uses. Exceptions include locally contaminated shallow groundwater where surface discharges or leaching have produced elevated concentrations of water quality constituents of concern. Examples include an ongoing remediation effort at a coastal refinery (in the unused shallow aquifer only), areas of nitrate contamination and a water supply well which has 1,2,3-Trichloropropane (1,2,3-TCP) concentrations slightly higher than the notification level of 5 ng/L. In most cases, these contaminants exist locally and are being monitored and managed with the oversight of local and regional regulatory agencies.

Groundwater from inland wells has a wide range of groundwater quality composition and can be variable, both between wells with similar groundwater elevations drawing water from the same aquifer, and over time within a single well. Chloride and total dissolved solids concentrations in samples from inland deep aquifer groundwater wells have been relatively constant over time, while groundwater in some shallow dune sand aquifer wells exhibits elevated nitrate concentrations or increasing salinity. During 2020, 65 water supply wells in addition to 16 monitoring wells and 17 environmental monitoring wells were sampled at least once for water quality; many were sampled multiple times during the year for many water quality constituents. The water quality components evaluated vary by well and sampling periods depending on the purpose of sampling and on regulatory requirements.

Approximately ten water supply wells that produce at least in part or primarily from the deep groundwater aquifer are known to have water quality with nitrate concentrations at, or in excess of primary drinking water maximum contaminant levels, or with iron and manganese concentrations in excess of secondary drinking water maximum contaminant levels. Iron and manganese water quality concerns are historically limited to a few wells in the southern NMMA.

Nitrate concentrations of at least half the MCL are documented for more than two dozen water supply wells, up to one and half times the MCL, and are located throughout the inland portions of the NMMA. Such groundwater must be treated or blended before it can be used in potable water systems. In the shallow aquifer, groundwater is observed to have nitrate concentrations up to ten times the MCL in local sampling, though none of these wells is used for water supply.

No other water quality constituents are currently known to restrict local use of groundwater supplies for domestic or irrigation purposes.

Nitrate: Elevated nitrate concentrations in groundwater generally result from anthropogenic causes. Nitrate is mainly a potable water concern (as compared to a concern for irrigation water).

Of the 65 water supply production wells sampled in CY 2020, water samples from three wells had nitrate concentrations in excess of the nitrate drinking water standard maximum contaminants level (MCL) at least once. Water samples from another production well screened in the principal producing aquifers have long-term elevated iron and manganese concentrations greater than the secondary MCL and require treatment or blending prior to use.

Chloride: A primary concern for both drinking water and irrigation use is high chloride concentrations. Depending upon the crop, chloride concentrations well below the secondary MCL of 500 mg/L can cause leaf burn, plant stunting, and plant death. Elevated chloride concentrations can occur in groundwater, especially in shallow or unconfined aquifers, from the recharge of return flows and tidal.

In CY 2020, chloride concentrations measured in coastal monitoring wells and in deep aquifer water supply wells were below 100 mg/L, with little change from previous years. Chloride concentrations up to 170 mg/L were observed in groundwater from shallow monitoring wells near industrial and wastewater facilities, well below the secondary MCL of 250 mg/L.

Total Dissolved Solids (TDS): In CY 2020, concentrations of TDS were mostly at or below 1,000 mg/L, the California recommended secondary standard, and are largely unchanged from previous years. Groundwater from one water supply well in the deep aquifer had TDS concentrations as high as 1,100 mg/L. Elsewhere within the NMMA, TDS concentrations for the deep aquifer in CY 2020 varied considerably, from 200 to 690 mg/L. In the shallow aquifer, TDS concentrations in CY 2020 ranged between 140 and 1,230 mg/L.

Hydrocarbons and Trace Metals. Two local sites of known or potential soil and shallow groundwater contamination are described by environment assessments or ongoing monitoring activity within the NMMA. The open sites are regulated by the RWQCB and are subject to corresponding monitoring, assessment or other action (Table 6-1).

Table 6-1. 2020 State Water Resources Control Board GeoTracker Open Sites

Site Name	Address	Status	Notes
Conoco Phillips Line 300	Tefft St at Carrillo St	Open; Site Assessment	Petroleum hydrocarbon impacts to soil and shallow groundwater adjacent to two petroleum pipelines (P66 & Unocal). No cleanup actions required as of 2020.
Phillips 66 Refinery, Santa Maria Facility	2555 Willow Rd	Open; Site Assessment and Interim Remedial Action	Metals, petroleum hydrocarbon and related organic contaminants in vicinity of former coke pile and slops line. LNAPL recovery from soils and shallow aquifer ongoing.
Source: http://geotracker.waterboards.ca.gov			

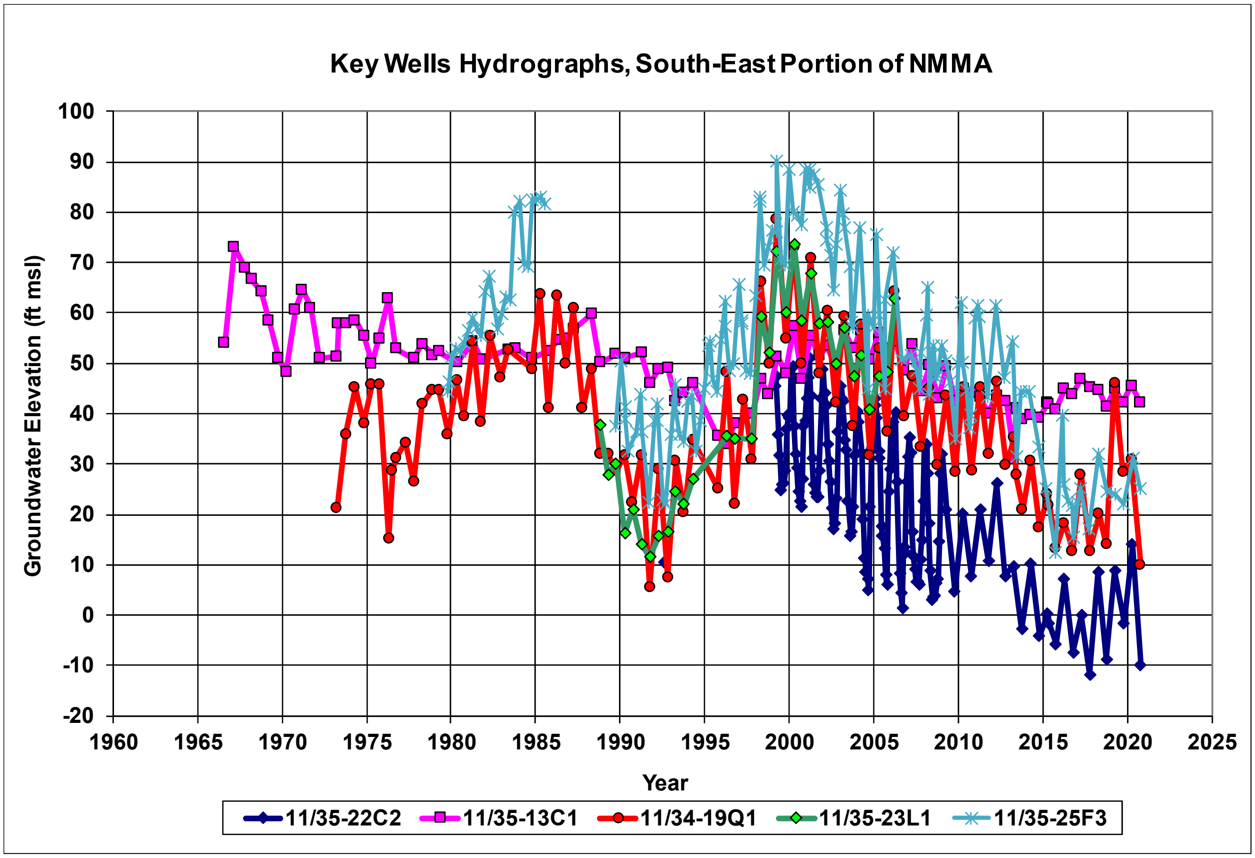

Figure 6-1. Key Wells Hydrographs, South-East Portion of NMMA

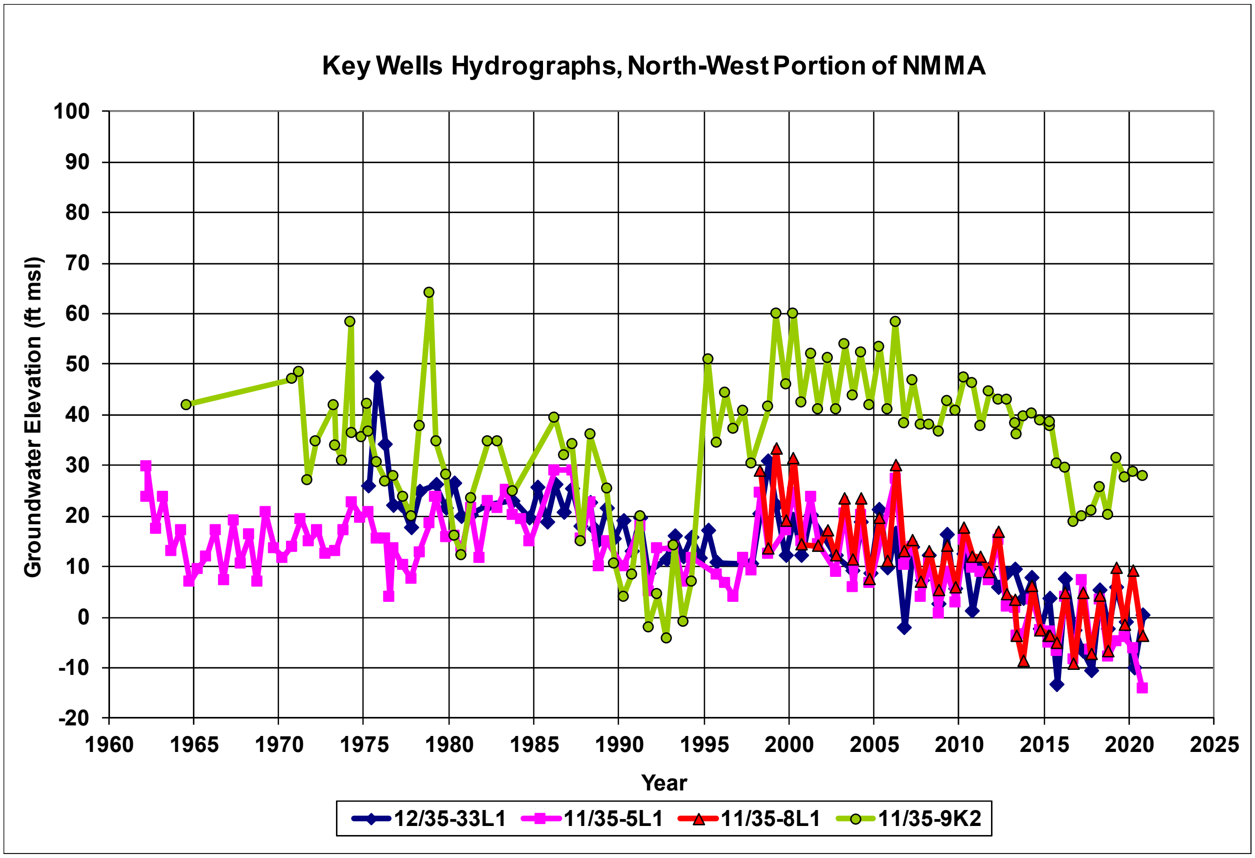

Figure 6-2. Key Wells Hydrographs, North-West Portion of NMMA

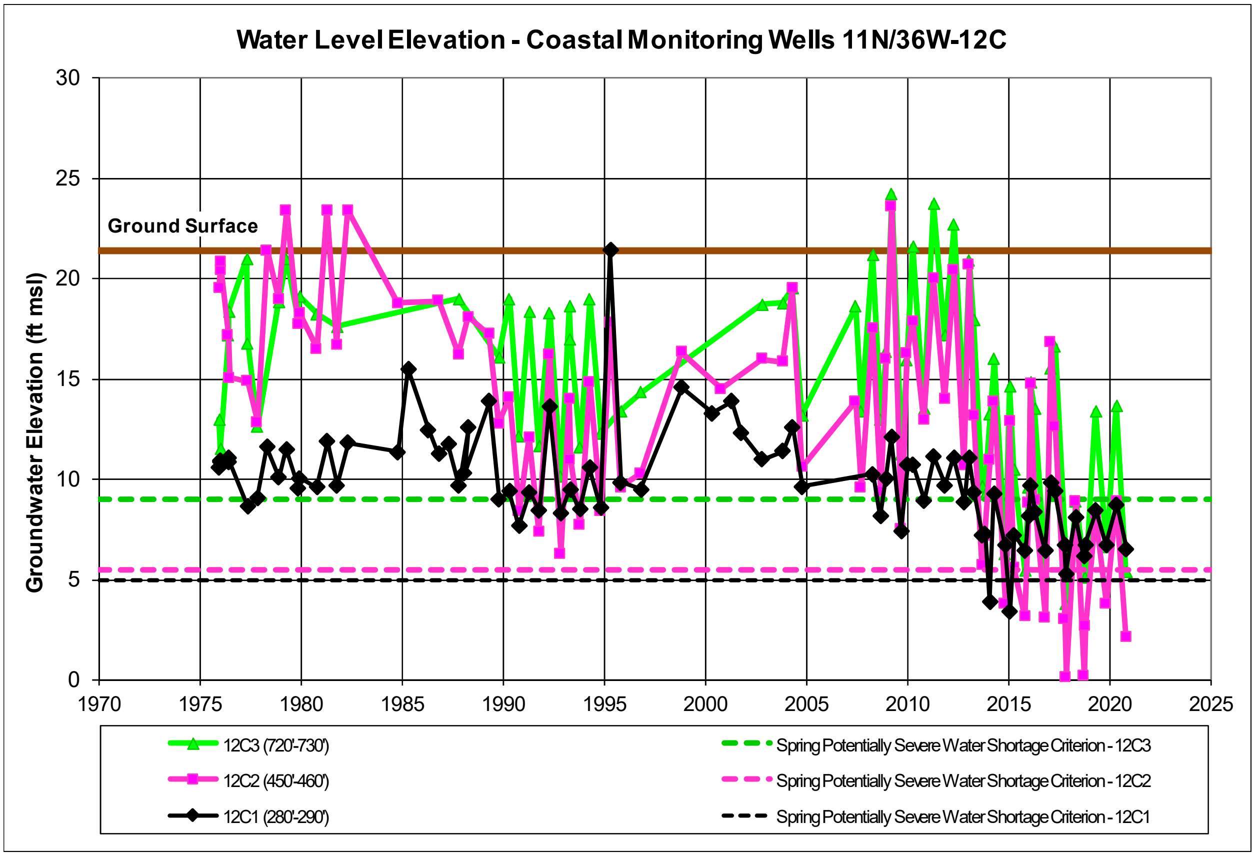

Figure 6-3. Hydrograph for Coastal Monitoring Well Nest 11N/36W-12C Note: Water levels measured under artesian flow prior to 2008 were observed without measuring the hydraulic head and recorded as a default value of 2 feet above the casing.

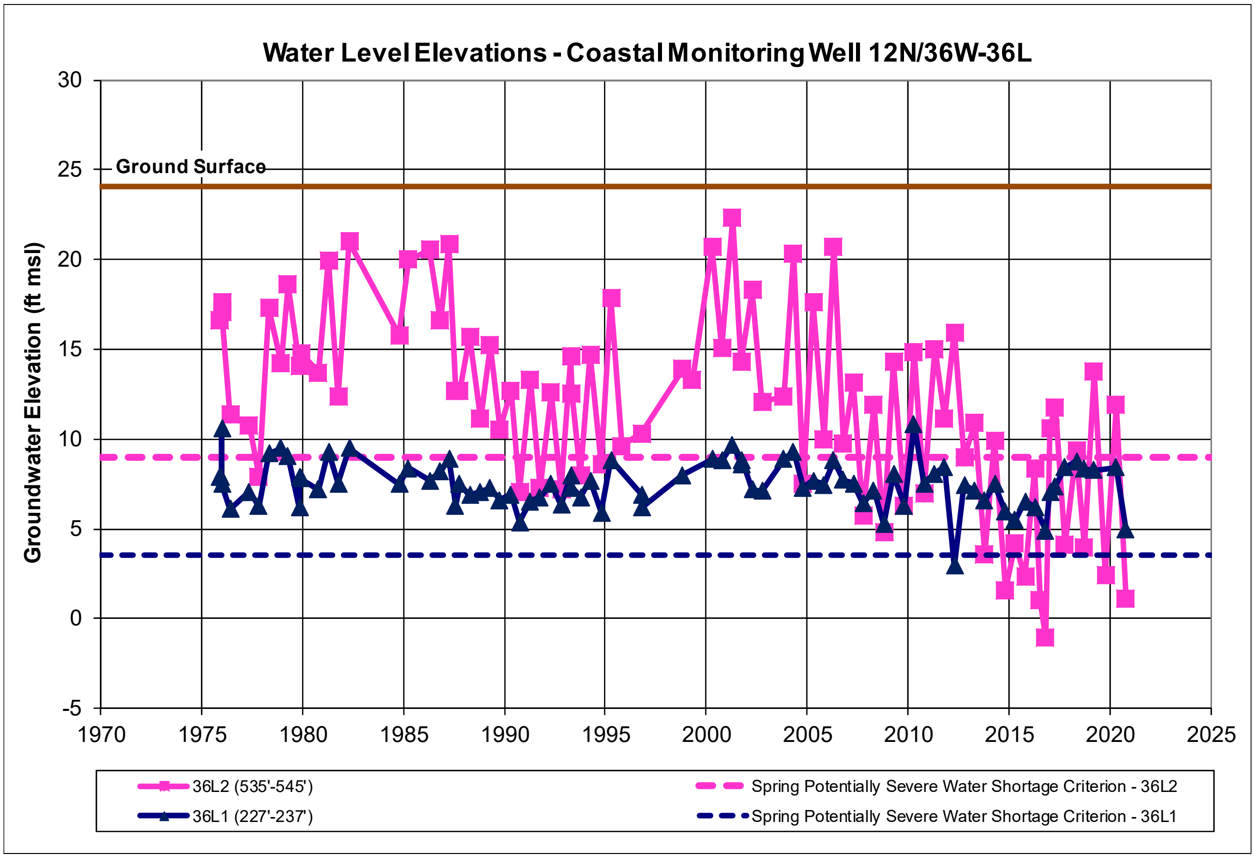

Figure 6-4. Hydrograph for Coastal Monitoring Well Nest 12N/36W-36L

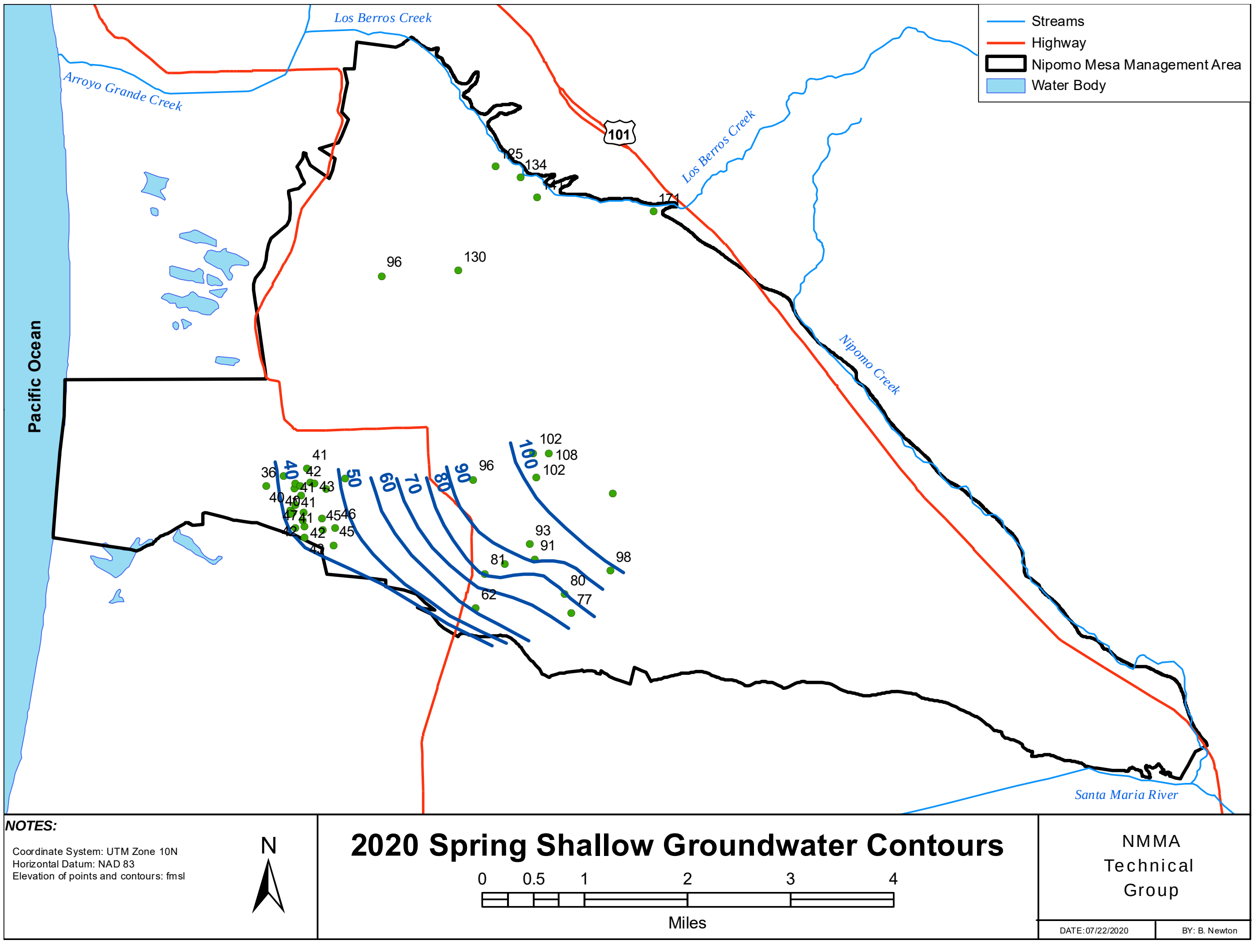

Figure 6-5. 2020 Spring Shallow Aquifer Groundwater Contours

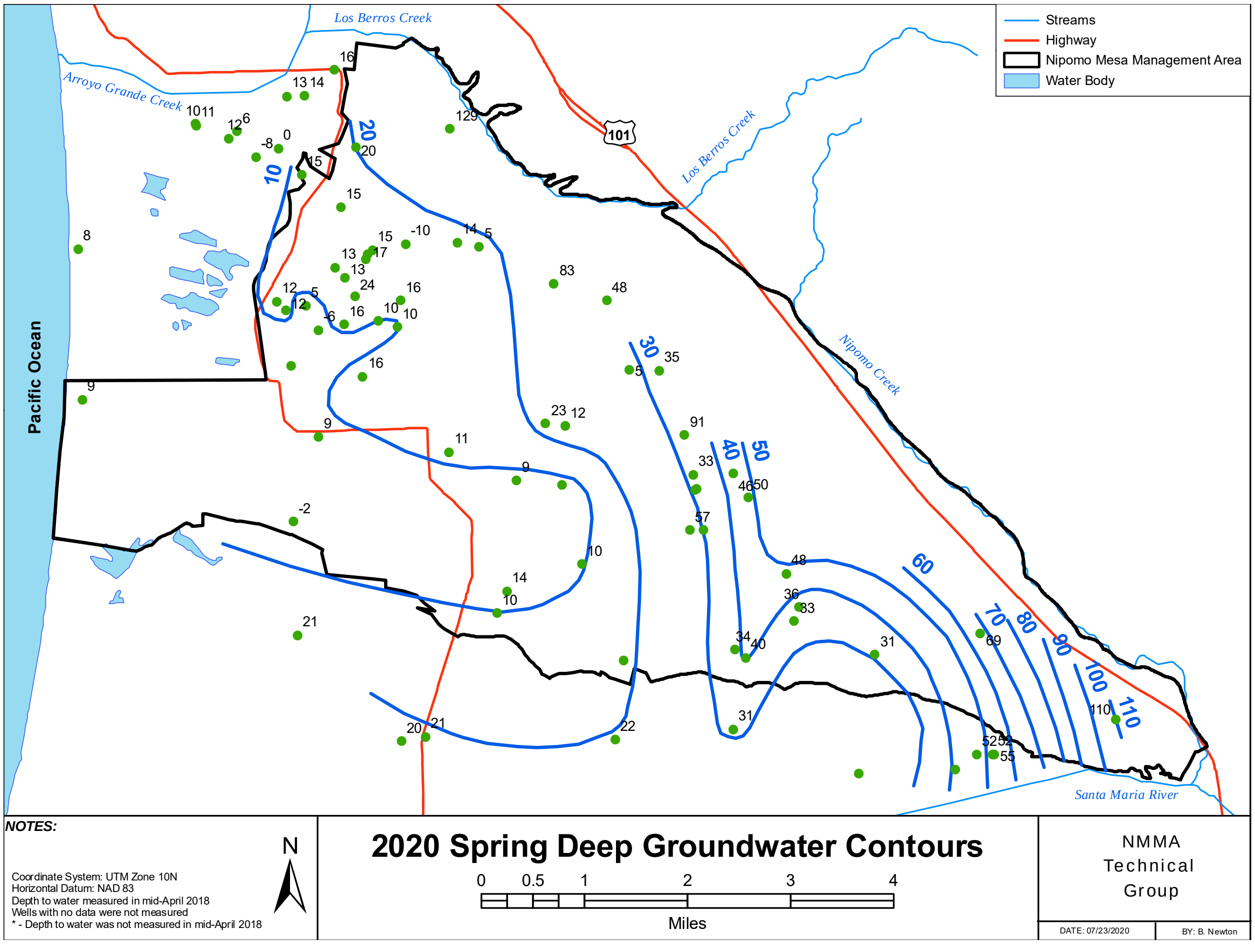

Figure 6-6. 2020 Spring Deep Aquifer Groundwater Contours

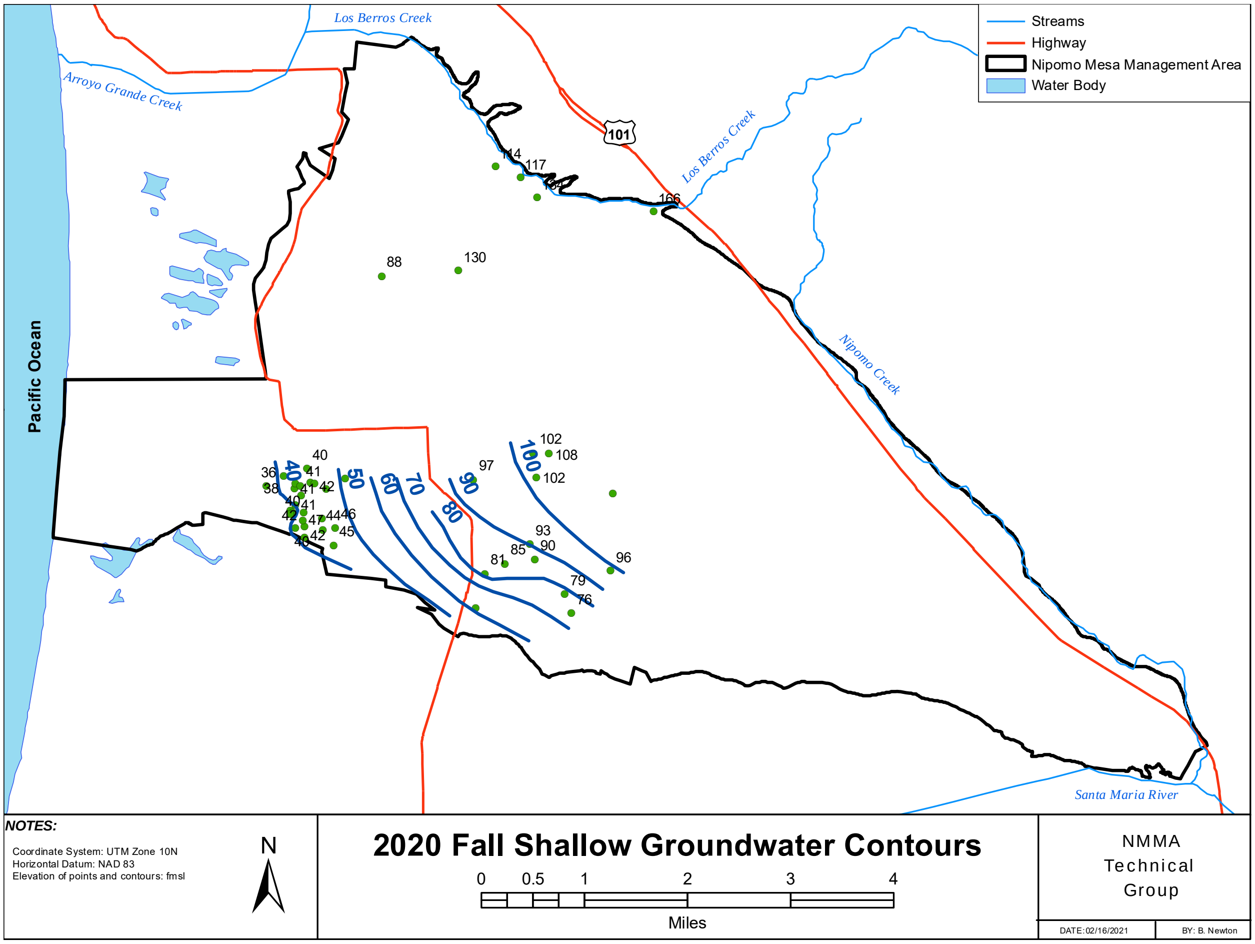

Figure 6-7. 2020 Fall Shallow Aquifer Groundwater Contours

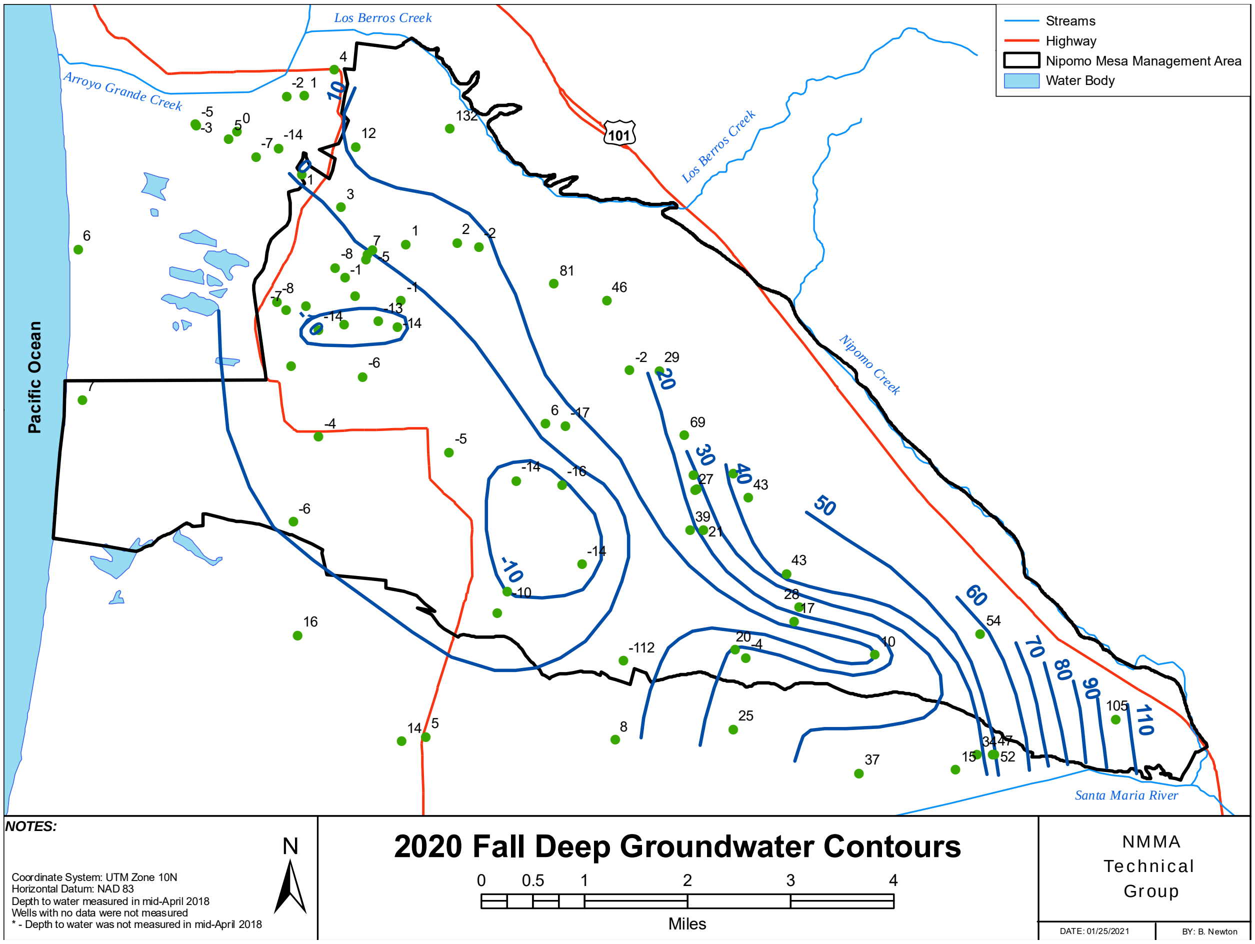

Figure 6-8. 2020 Fall Deep Aquifer Groundwater Contours

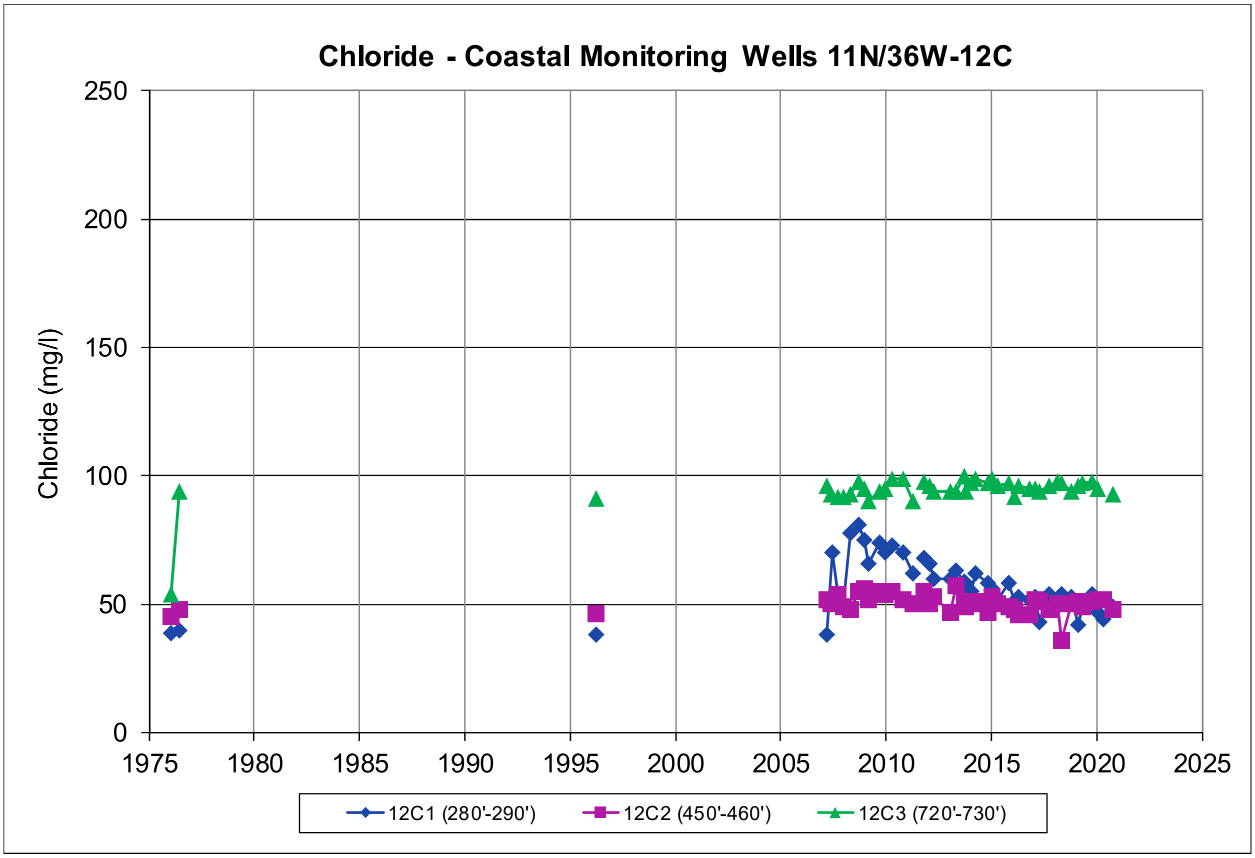

Figure 6-9. Chloride in Coastal Wells 11N/36W-12C 1, 2, and 3

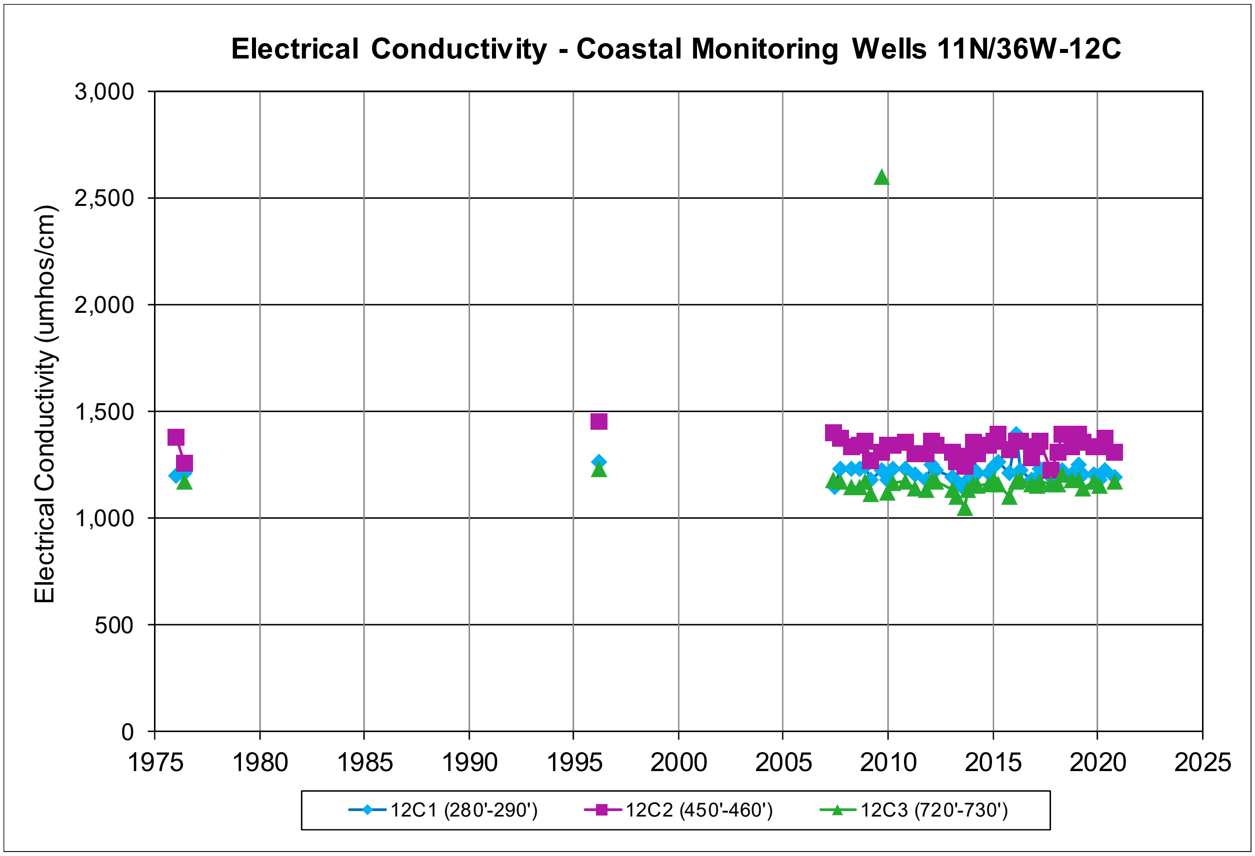

Figure 6-10. Electrical Conductivity in Coastal Wells 11N/36W-12C 1, 2, and 3

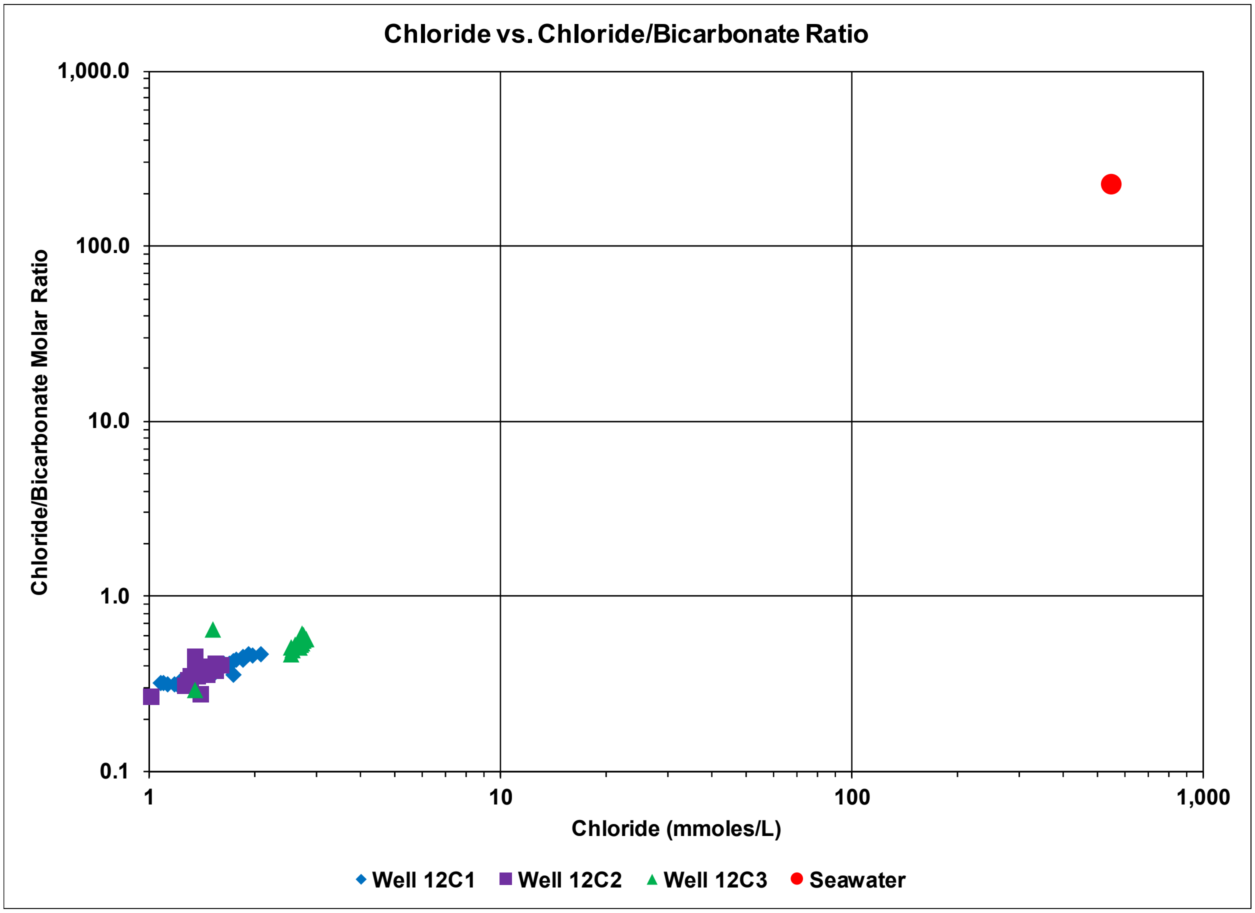

Figure 6-11. Chloride vs Chloride/Bicarbonate Ratio for Coastal Wells

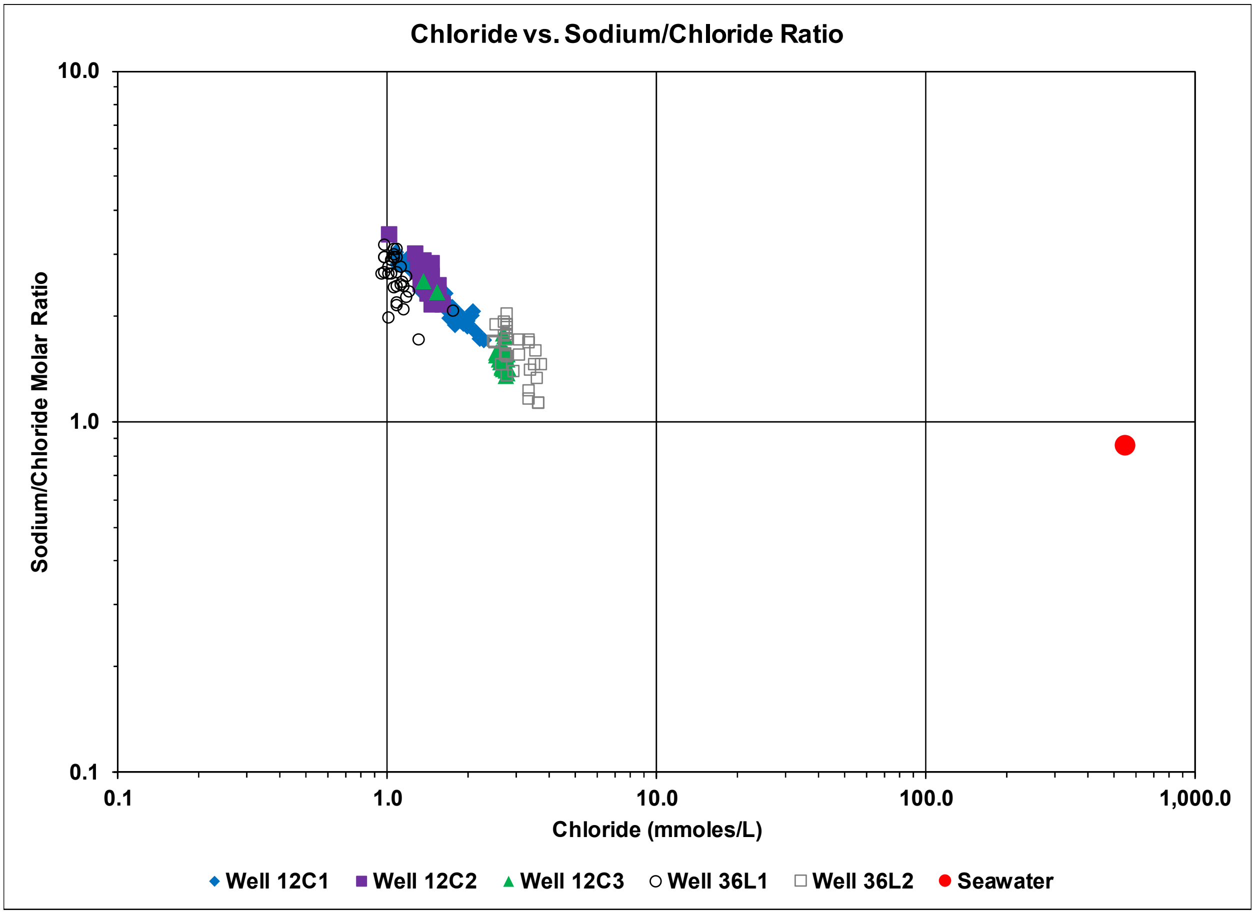

Figure 6-12. Chloride vs Sodium/Chloride Ratio for Coastal Wells

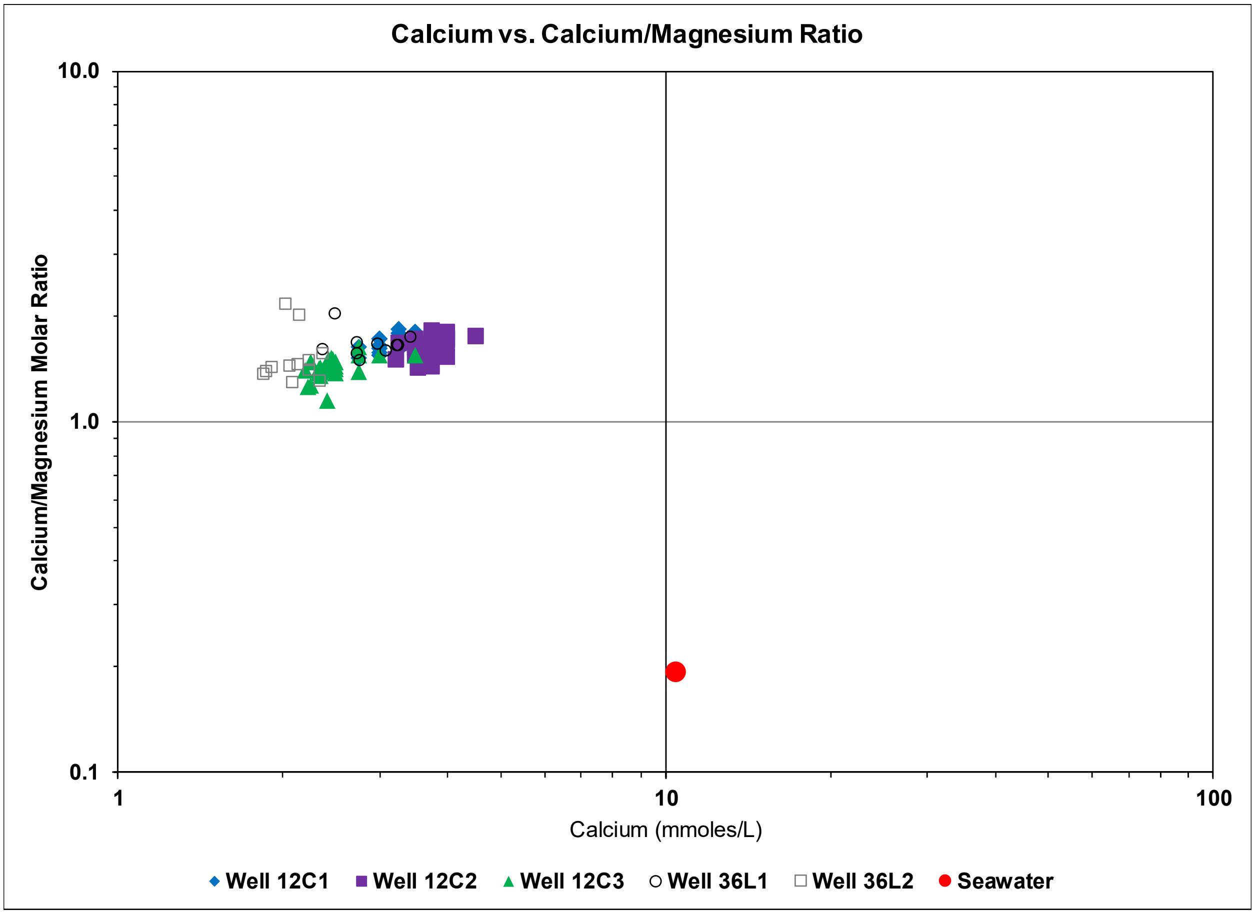

Figure 6-13. Calcium vs Calcium/Magnesium Ratio for Coastal Wells

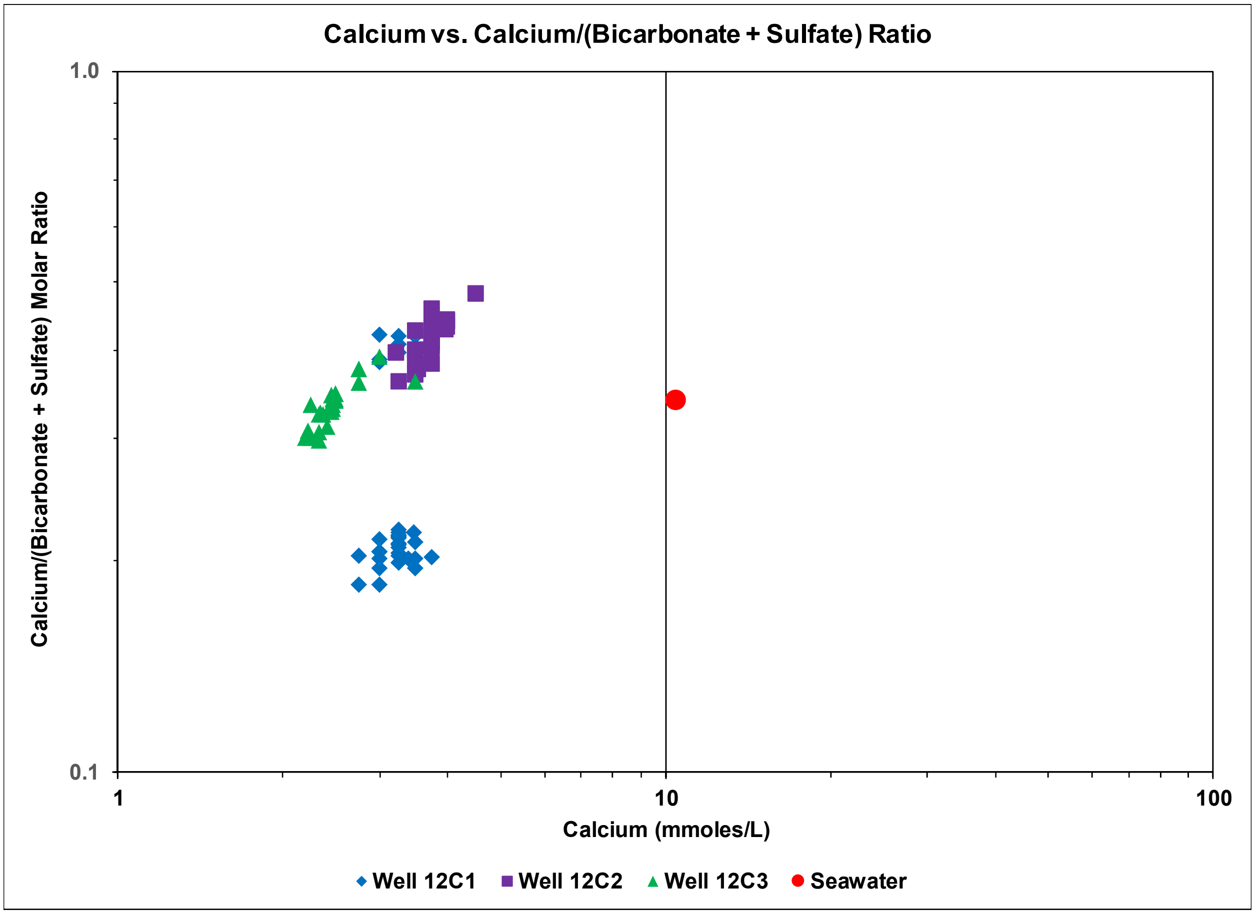

Figure 6-14. Calcium vs Calcium/(Bicarbonate + Sulfate) Ratio for Coastal Wells

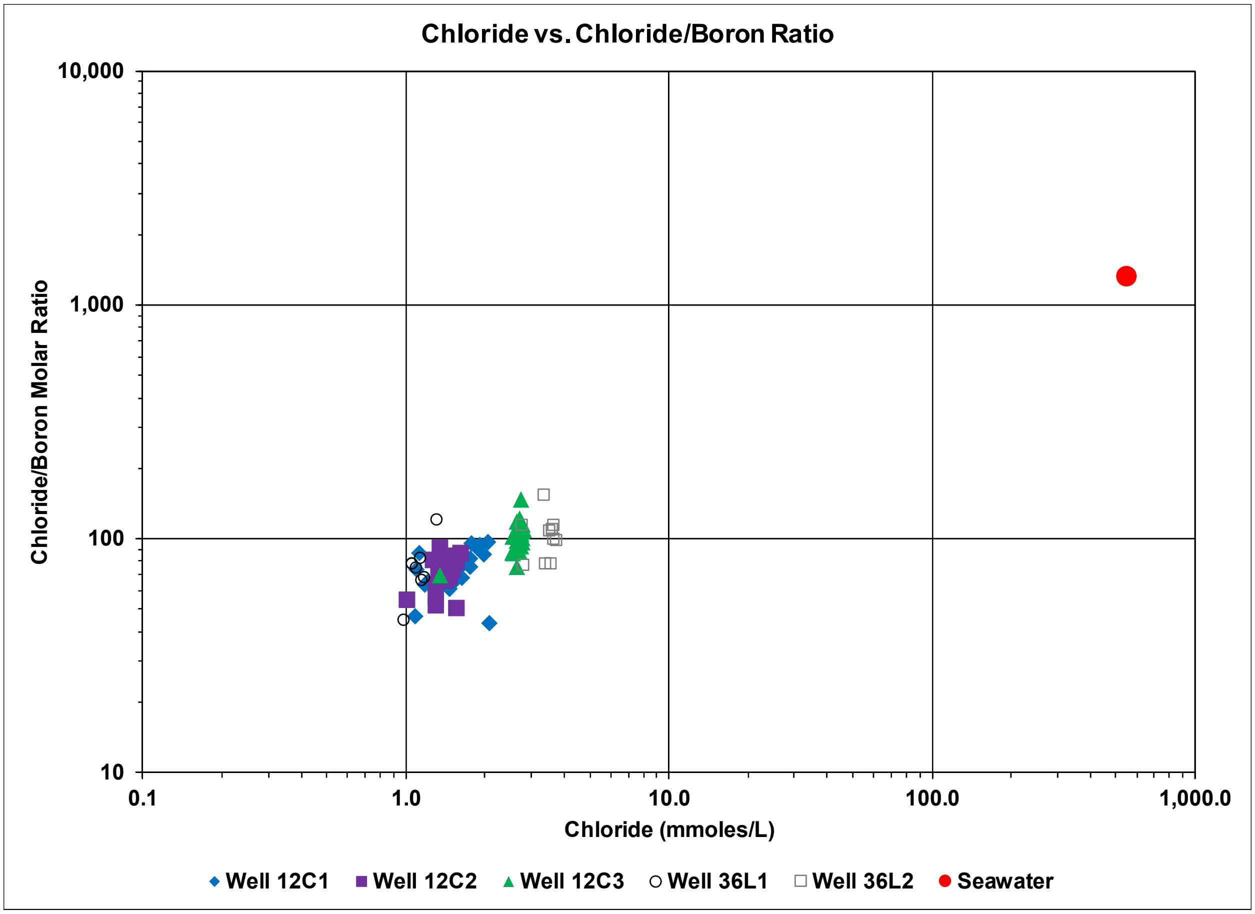

Figure 6-15. Chloride vs Chloride/Boron Ratio for Coastal Wells

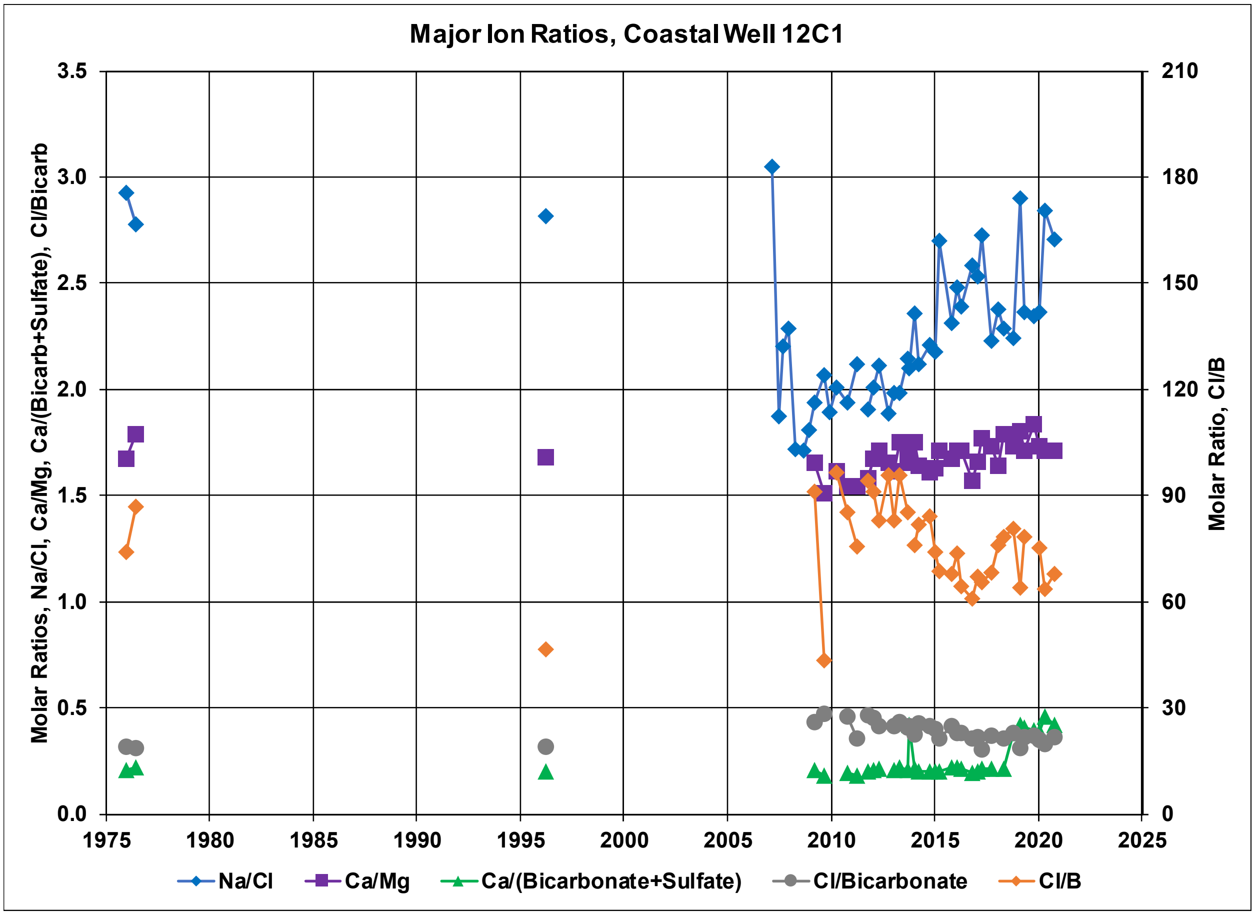

Figure 6-16. Major Ion Ratios for Coastal Well 12C1

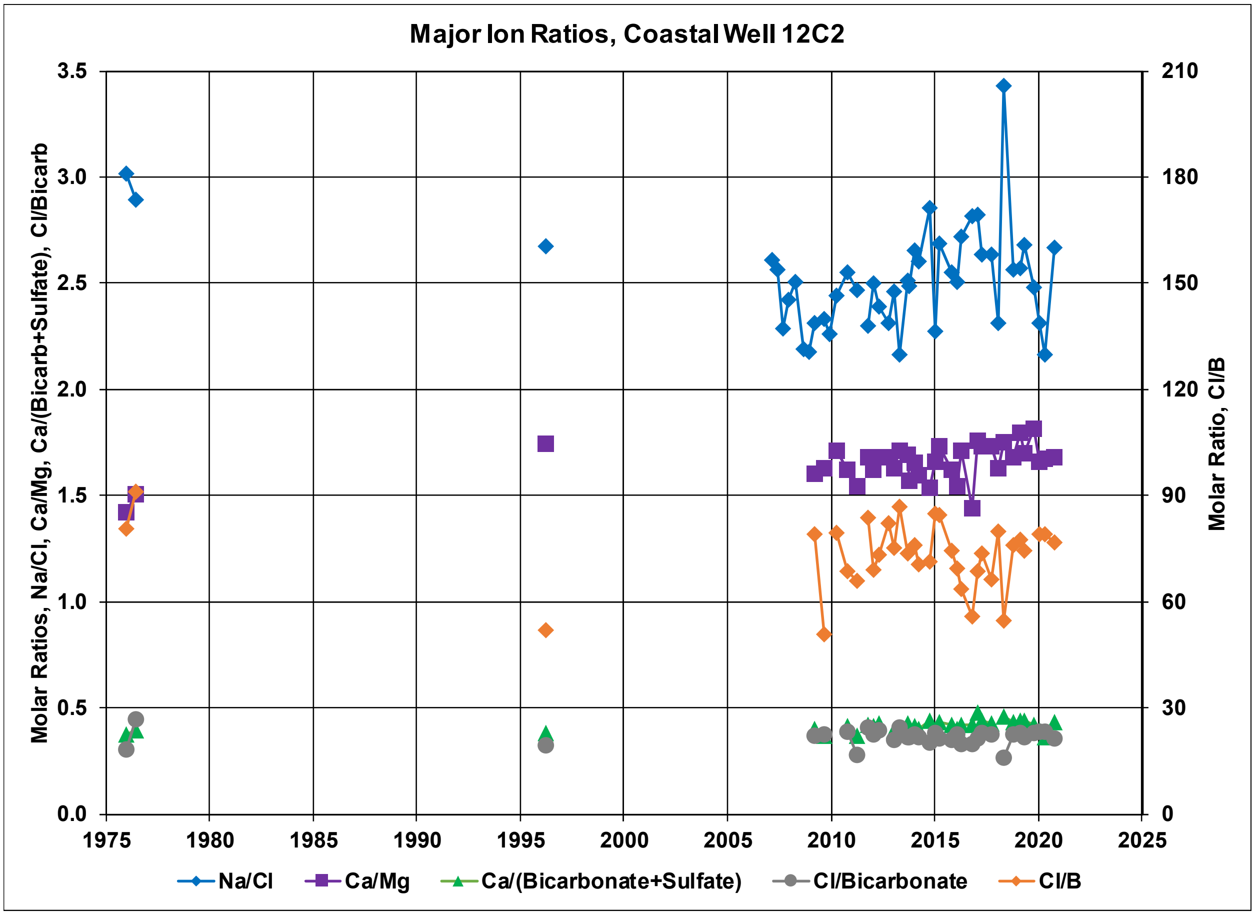

Figure 6-17. Major Ion Ratio for Coastal Well 12C2

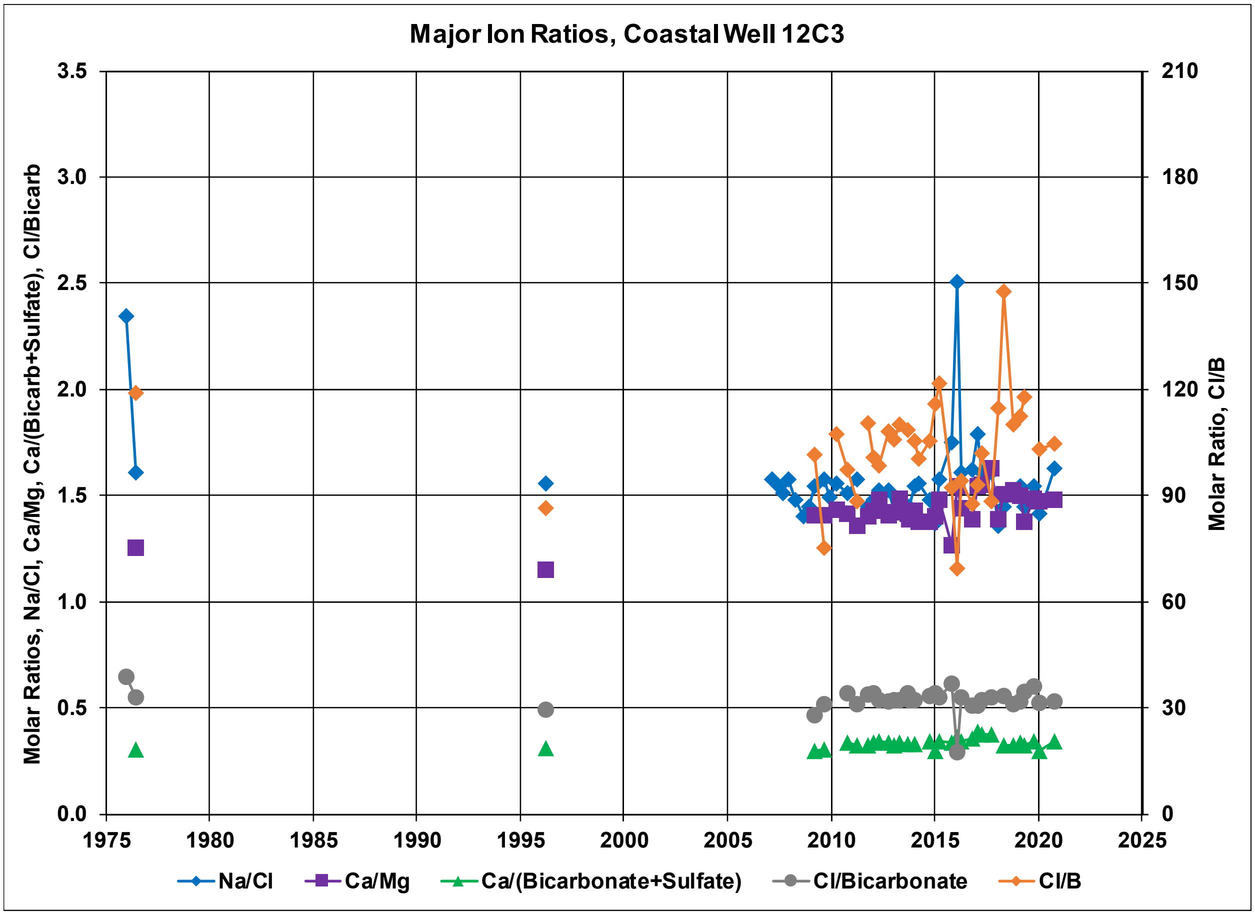

Figure 6-18. Major Ion Ratio for Coastal Well 12C3

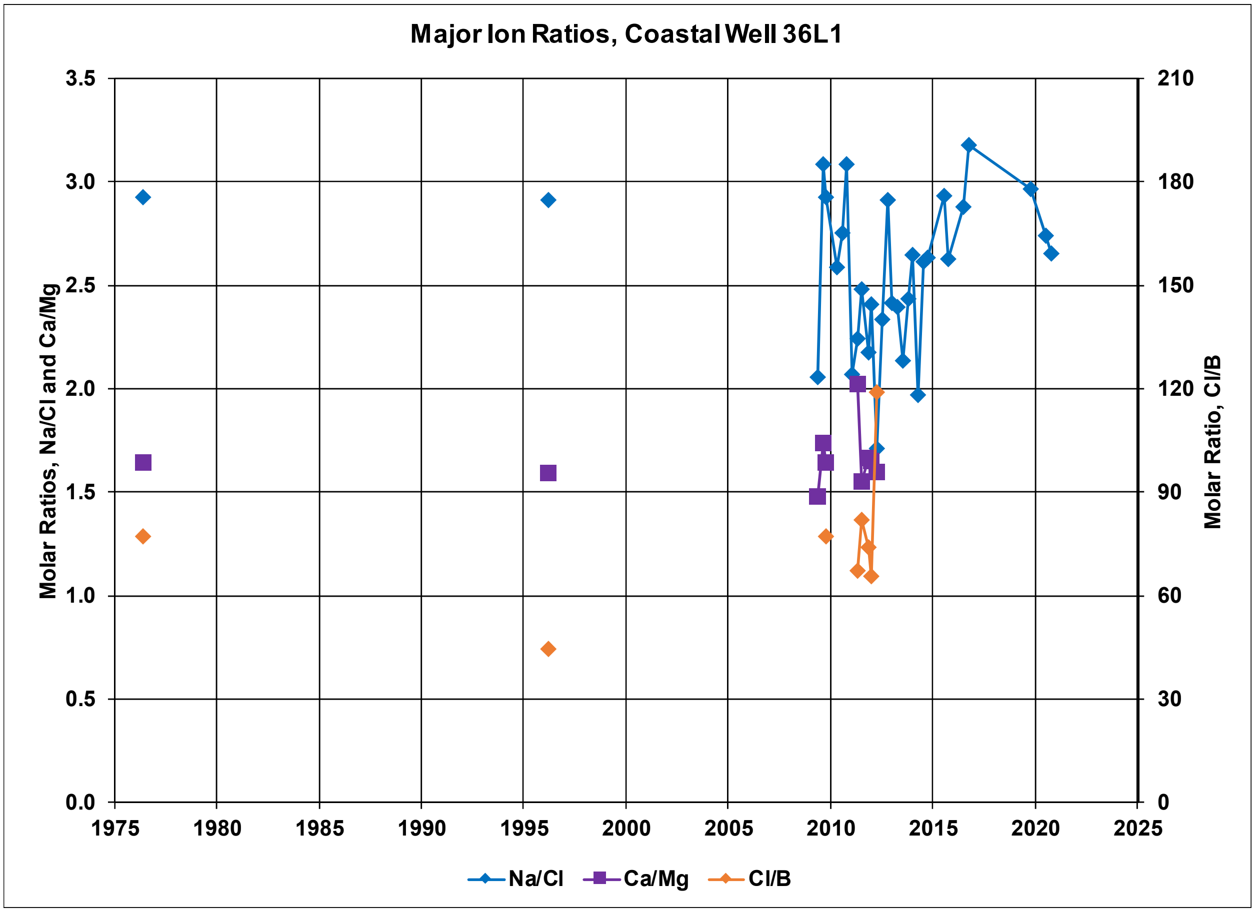

Figure 6-19. Major Ion Ratio for Coastal Well 36L1

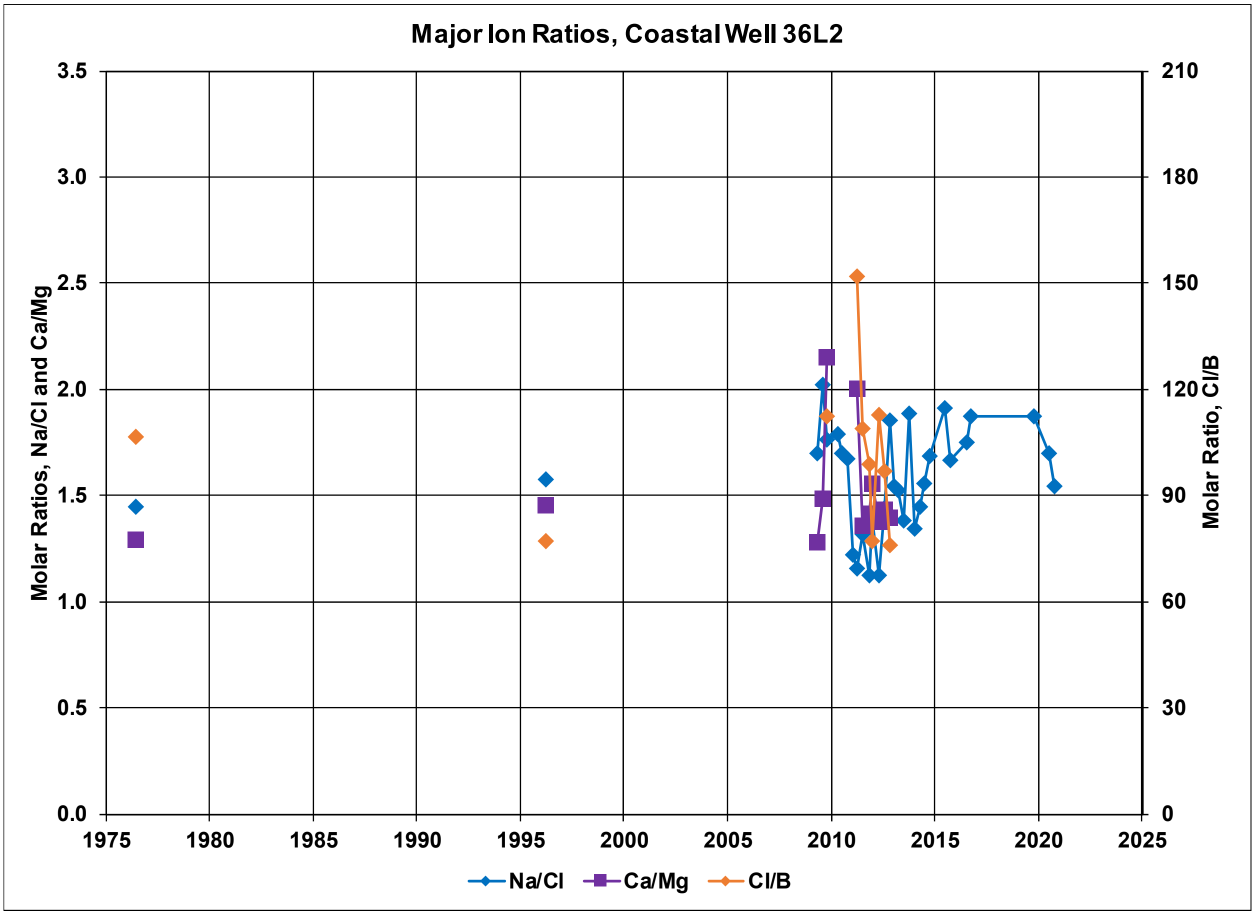

Figure 6-20. Major Ion Ratio for Coastal Well 36L2

7. Analyses of Water Conditions

Stipulation requirements, water shortage conditions, and long-term trends are presented in the following sections.

7.1. *Stipulation Requirements*

The Stipulation requires the determination of the water shortage condition as part of the Annual Report. Water shortage conditions are characterized by criteria designed to reflect that groundwater levels beneath the NMMA as a whole are at a point at which a response would be triggered to avoid further declines in groundwater levels (Potentially Severe), and to declare that the lowest historical groundwater levels beneath the NMMA as a whole have been reached or that conditions constituting seawater intrusion have been reached (Severe).

Potentially Severe Water Shortage Conditions

The Stipulation, page 25, defines Potentially Severe Water Conditions as follows:

Caution trigger point (Potentially Severe Water Shortage Conditions)

(a) Characteristics. The NMMA Technical Group shall develop criteria for declaring the existence of Potentially Severe Water Shortage Conditions. These criteria shall be approved by the Court and entered as a modification to this Stipulation or the judgment to be entered based upon this Stipulation. Such criteria shall be designed to reflect that water levels beneath the NMMA as a whole are at a point at which voluntary conservation measures, augmentation of supply, or other steps may be desirable or necessary to avoid further declines in water levels.

Severe Water Shortage Conditions

The Stipulation, page 25, defines Severe Water Conditions as follows:

Mandatory action trigger point (Severe Water Shortage Conditions)

(a) Characteristics. The NMMA Technical Group shall develop the criteria for declaring that the lowest historic water levels beneath the NMMA as a whole have been reached or that conditions constituting seawater intrusion have been reached. These criteria shall be approved by the Court and entered as a modification to this Stipulation or the judgment to be entered based upon this Stipulation.

7.2. ***Water Shortage Conditions***

7.2.1. Inland Criteria

The inland criteria for water shortage conditions is the Key Wells Index. The 2020 Key Wells Index was 11.7 ft msl, indicating Severe Water Shortage Conditions (Figure 7-1).

Key Wells Index

The Key Wells Index indicates trends in groundwater elevations within inland areas of the NMMA, and is intended to reflect whether there is a general balance between inflows and outflows in the NMMA. There was a decrease in the Key Wells Index in 2020, which continues to meet the criteria for Severe Water Shortage Conditions (Figure 7-1). Groundwater elevations in several of the wells that make up the Key Wells Index have generally declined since about 2000 (see Section 6.1.1 Results from Key Wells).

7.2.2. Coastal Criteria

Coastal groundwater elevations and water quality were better than Potentially Severe Water Shortage Conditions for all criteria in Spring 2019 (Table 7-1).

Table 7-1. Criteria for Potentially Severe Water Shortage Conditions

Well	Perforations Elevations (ft msl)	Aquifer	Spring 2020 Elevations (ft msl)	Elevation Criteria (ft msl)	2020 Highest Chloride (mg/L)	Chloride Concentration Criteria (mg/L)
11N/36W-12C1	-261 to -271	Paso Robles	8.73	**5.0**	49	**250**
11N/36W-12C2	-431 to -441	Pismo	8.91	**5.5**	52	**250**
11N/36W-12C3	-701 to -711	Pismo	13.67	**9.0**	95	**250**
12N/36W-36L1	-200 to -210	Paso Robles	8.42	**3.5**	40	**250**
12N/36W-36L2	-508 to -518	Pismo	11.88	**9.0**	100	**250**

7.2.3. Status of Water Shortage Conditions

The Key Wells Index remains below the Severe Water Shortage Conditions in 2020. Exiting the Severe Water Shortage Conditions requires two consecutive years where the Key Wells Index is above the level of Severe Water Shortage Conditions.

The responses discussed in the Stipulation are set forth as follows:

VI(D)(2b) Responses [Severe Water Shortage Conditions]. *As a first response, subparagraphs (i) through (iii) shall be imposed concurrently upon order of the Court. The Court may also order the Stipulating Parties to implement all or some portion of the additional responses provided in subparagraph below.*

(i) For Overlying Owners other than Woodlands Mutual Water Company and ConocoPhillips (now Phillips 66), *a reduction in the use of Groundwater to no more than 110% of the highest pooled amount previously collectively used by those Stipulating Parties in a Year, prorated for any partial Year in which implementation shall occur, unless one or more of those Stipulating Parties agrees to forego production for consideration received. Such forbearance shall cause an equivalent reduction I the pooled allowance. The base Year from which the calculation of any reduction is to be made may include any prior single Year up to the Year in which the Nipomo Supplemental Water is transmitted. The method of reducing pooled production to 110% is to be prescribed by the NMMA Technical Group and approved by the Court. The quantification of the pooled amount pursuant to this subsection shall be determined at the time the mandatory action trigger point (Severe Water Shortage Conditions) described in Paragraph VI(D)(2) is reached. The NMMA Technical Group shall determine a technically responsible and consistent method to determine the pooled amount and any individual's contribution to the pooled amount. If the NMMA Technical Group cannot agree upon a technically responsible and consistent method to determine the pooled amount, the matter may be determined by the Court pursuant to a noticed motion.*

(ii) ConocoPhillips (now Phillips 66) *shall reduce its Yearly Groundwater use to no more than 110% of the highest amount it previously used in a single Year, unless it agrees in writing to use less Groundwater for consideration received. The base Year from which the calculation of any reduction is to be made may include any prior single Year up to the Year in which the Nipomo Supplemental Water is transmitted. ConocoPhillips* (now Phillips 66) *shall have discretion in determining how reduction of its Groundwater use is achieved.*

(iii) NCSD, RWC, SCWC, and Woodlands (if applicable as provided in Paragraph VI(B)(3) above) shall implement those mandatory conservation measures prescribed by the NMMA Technical Group and approved by the Court.

(iv) If the Court finds that Management Area conditions have deteriorated since it first found Severe Water Shortage Conditions, the Court may impose further mandatory limitations on Groundwater use by NCSD, SCWC, RWC and the Woodlands. Mandatory measures designed to reduce water consumption, such as water reductions, water restrictions and rate increases for the purveyors, shall be considered.

(v) During Severe Water Shortage Conditions, the Stipulating Parties may make agreements for temporary transfer of rights to pump Native Groundwater voluntary fallowing, or the implementation of extraordinary conservation measures. Transfer Native Groundwater must benefit the Management Area and be approved by the Court.

Nipomo Mesa groundwater management options to address water shortage conditions include responses required under the Stipulation as well as other possible groundwater management actions to address a range of resource concerns associated with the current Severe Water Shortage Condition. TG concerns directly relating to groundwater conditions include:

- Depressed groundwater elevations, both as measured by the Key Wells Index and in specific portions of the management area;
- An onshore gradient for a large area of the coastal and central portions of the NMMA.

Potential actions to address the above concerns include a range of projects and activities already in place, in progress, or contemplated for future consideration. Many of these possibilities have been reviewed previously in water supply evaluations (SAIC, 2006; Kennedy-Jenks, 2001; Bookman-Edmonston, 1994).

Existing actions in the NMMA reviewed by the TG include

- Consistent with Stage IV of the NMMA Water Shortage Response Stages, a total reduction of 2,155 AF (-38%) in purveyor production was accomplished in 2020 as compared to 2013.
- Continued progress in 2020 on the NSWP (see Section 1.1.5 Supplemental Water).

Potential actions to be reviewed by the TG include

- Increased development of reclaimed water for certain NMMA water supply needs in lieu of pumping from the deep aquifers.

Different management options have different potential capacity to reduce demand or increase supply, and each has its own technical considerations. By way of example, and assuming regulatory agency approval and the establishment of an appropriate cost benefit that meets the requirements of California's Proposition 218 or the California Public Utilities Commission (CPUC), wastewater effluent that is not already reclaimed may be discharged in locations where wastewater effluent would have a beneficial effect on the deep aquifers and in areas closer to the coast.

Areas of special concern with regard to Severe Water Shortage Conditions have special significance if they experience beneficial results from projects to manage groundwater demands and overall supply. For example, the coastal portion of the NMMA has a component of landward groundwater flow in the deep aquifers and is potentially threatened by seawater intrusion. Actions that maintain a healthy seaward component of flow, protect the basin from potential seawater intrusion. Similarly, the pumping depression in the central portion of the NMMA has long-standing groundwater levels below sea level and is a pronounced feature of the principal production aquifers in the NMMA (Figure 6-6, Figure 6-8). Allowing water levels to rebound in this area would also help to reestablish and maintain protective groundwater gradients.

7.3. ***Long-term Trends***

Long-term trends in climate, land use, and water use are presented in the following sections.

7.3.1. Climatological Trends

Climatological trends have been identified through the use of cumulative departure from mean analyses. A cumulative departure from the mean represents the accumulation, since the beginning of the period of record, of the differences (departures) in annual total rainfall volume from the mean value for the period of record. Each year's departure is added to or subtracted from the previous year's cumulative total, depending on whether that year's departure was above or below the mean annual rainfall depth. When the slope of the cumulative departure from the mean is negative (i.e., downward), the sequence of years is drier than the mean, and conversely when the slope of the cumulative departure from the mean is positive (i.e., upward), the sequence of years is wetter than the mean. The cumulative departures from the mean were computed for the rainfall station Mehlschau (38), which has the longest rainfall record for the NMMA (Figure 7-2).

Historical rainfall records for the Nipomo Mesa begin in 1920. There are three significant long-term dry periods in the record, from 1921 to 1934, from 1944 to 1951, and from 1984 to 1991. Long-term dry periods have occurred in the last 90 years that are longer in duration than the 1987 to 1992 drought (Figure 7-2). Between each large dry period, three wet periods have occurred. These wet periods are from 1935 to 1943, from 1977 to 1983, and from 1994 to 2001.

The period of analyses (1975-2020) used by the TG is roughly 8 percent "wetter" on average than the long-term record (1920-2020) indicating a slight bias toward overestimating the amount of local water supply resulting from percolation of rainfall. WY 2007, WY 2008, and WY 2009 had less than average rainfall. WY 2007 was approximately 45 percent to 50 percent of average rainfall, WY 2008 was approximately 94 percent to 97 percent of average rain fall, and WY 2009 was approximately 67 percent to 73 percent of average rain fall. During WY 2010 (20.1 inches) and WY 2011 (34.1 inches), rainfall was approximately 130 percent and 180 percent of average conditions (Table 3-2). Annual rainfall was below average during WY 2012 to WY 2016, above average in WY 2017, and below average in 2018. Rainfall was just below average during WY 2012 (15.4 inches), approximately 50 percent of average in WY 2013 (8.1 inches), 30 percent of average rainfall in WY 2014 (4.7 inches), approximately 50 percent of average in WY 2015 (8.1 inches), approximately 66 percent of average in WY 2016 (10.1 inches), approximately 175 percent of the average in WY 2017, approximately 58 percent of the average in WY 2018, and approximately 150 percent of the average in WY 2019. Based on the rainfall totals, 2020 is the seventh year with below average rainfall out of the past nine years.

7.3.2. Land Use Trends

The DWR periodically has performed land use surveys of the South Central Coast of California, which includes the NMMA: in 1958, 1969, 1977, 1985, and 1996. A land use survey for only the NMMA was performed by the TG in 2007 based on 2007 aerial photography (see Section 3.1.8 Land

Use). The most recent survey occurred in 2013 by performing aerial imagery analysis, reviewing observations made by NMMA TG engineer representatives, and assessing San Luis Obispo County pesticide purchase reports. Based on these surveys, land use in the NMMA has changed dramatically over the past half-century (Table 7-2, Figure 7-3, and Figure 7-4). Urban development has replaced native vegetation over the past 20 years, changing by a factor of two. Total agriculture acreage has approximately doubled from 1959 (see Section 3.1.8 Land Use).

Table 7-2. NMMA Land Use – 1959 to 2020 (acres)

	1959	1968	1977	1985	1996	2007	2013	2014	2020
Agricultural	1,600	2,000	2,000	2,200	2,000	2,600	2,970	2,970	2,988
Urban	300	700	2,200	3,300	5,800	10,200	10,460	10,670	10,596
Native	19,200	18,400	16,900	15,600	13,300	8,300	7,670	7,460	7,957
Total	21,100	21,100	21,100	21,100	21,100	21,100	21,100	21,100	21,541

7.3.3. Stipulating Party Water Use Trends

Consistent with Stage IV of the NMMA Water Shortage Response Stages, a total reduction of 2,155 AF (-38%) in production was accomplished in 2020 as compared to 2013. NCSD reduced groundwater production in 2020 by 62%, GSWC increased groundwater production by 14%, and Woodlands increased groundwater production by 11%, as compared to 2013 (Table 7-3).

Table 7-3. Groundwater Production by Purveyor from 2008 to 2020

Groundwater Production (AFY)													
Purveyors	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
NCSD	2,700	2,560	2,370	2,488	2,472	2,646	2,224	1,626	1,087	999	1,003	901	1,008
GSWC	1,380	1,290	1,060	1,043	1,103	1,169	940	786	1,340	1,292	1,316	1,193	1,332
Woodlands	540	810	850	864	857	1,016	856	871	1,029	1,088	1,366	1,066	1,131
RWC	900	880	720	728	763	795	688	651	*	*	*	*	*
Total	**5,520**	**5,540**	**5,000**	**5,123**	**5,195**	**5,626**	**4,708**	**3,934**	**3,456**	**3,379**	**3,684**	**3,160**	**3,471**
* - As of 2016, Production is included in GSWC													

7.3.4. Trends in Basin Inflow and Outflow

The estimated groundwater production is 14,313 AF for CY 2020, which is about two and a half times the groundwater production in 1975 (Figure 4-1), confirming a trend of increased groundwater production over the last 44 years, although there was a downward trend since 2013 due to conservation by urban users in the face of prolonged drought. The estimated consumptive use of water for urban, agricultural and golf course, and industrial use for CY 2020 is 13,376 AF (Section 5.7).

Contours of groundwater elevations suggest that there is likely some inflow of groundwater from the SMVMA, a flat gradient between NCMA and NMMA, and likely landward groundwater flow from the coastal zone.

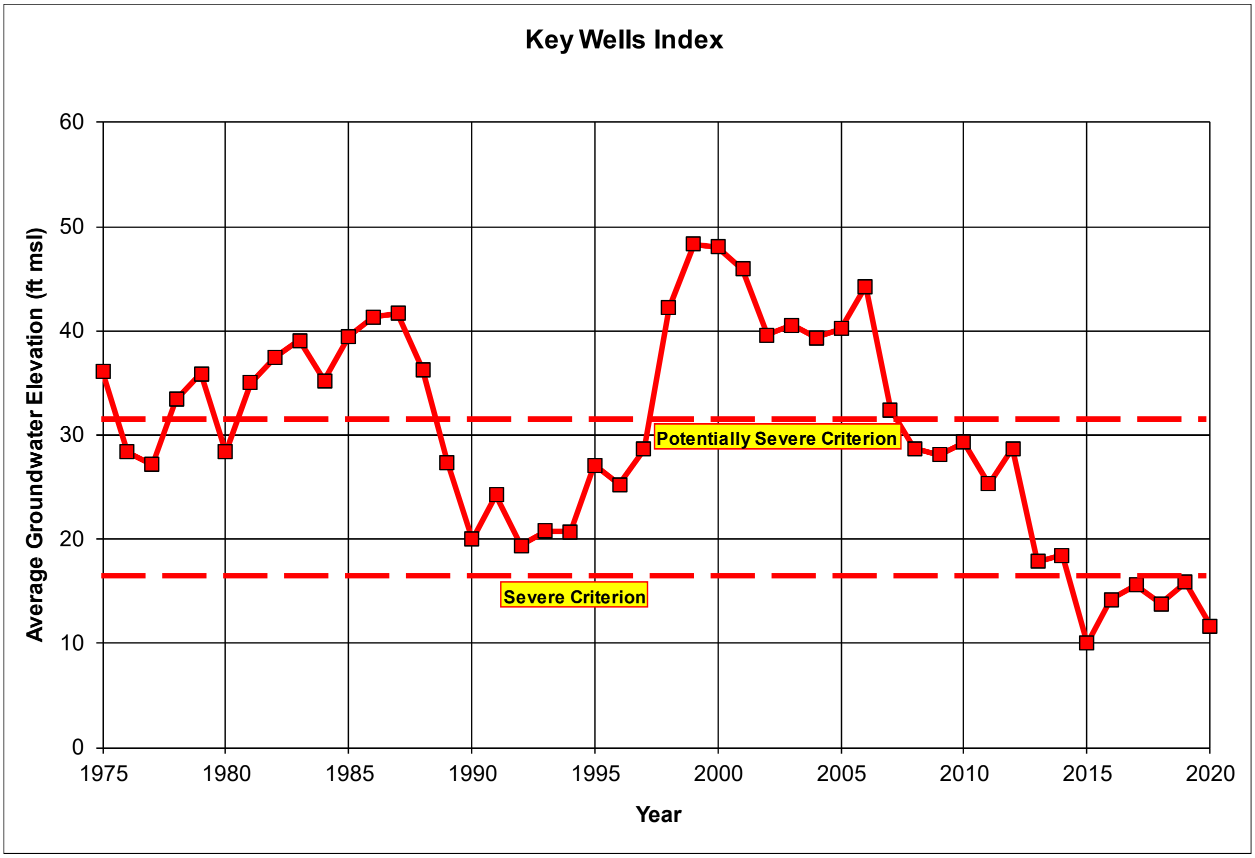

Figure 7-1. Key Wells Index *The upper dashed line is the criterion for Potentially Severe Water Shortage Conditions and the lower dashed line is the criterion for Severe Water Shortage Conditions.*

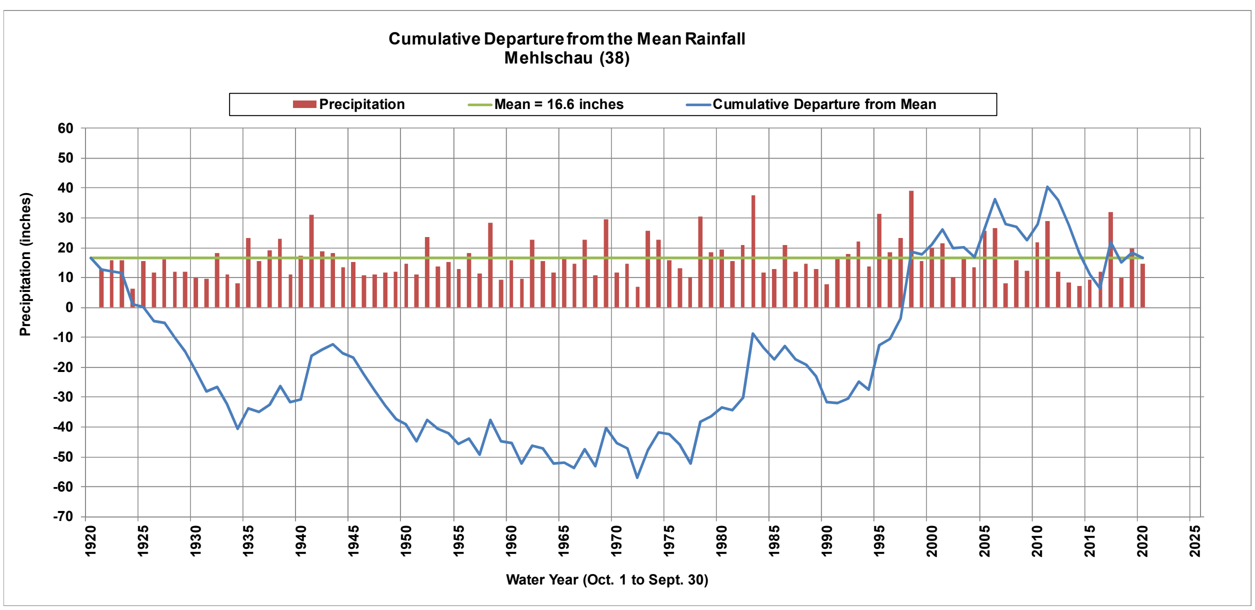

Figure 7-2. Rainfall: Cumulative Departure from the Mean – Rainfall Gauge Mehlschau (38).

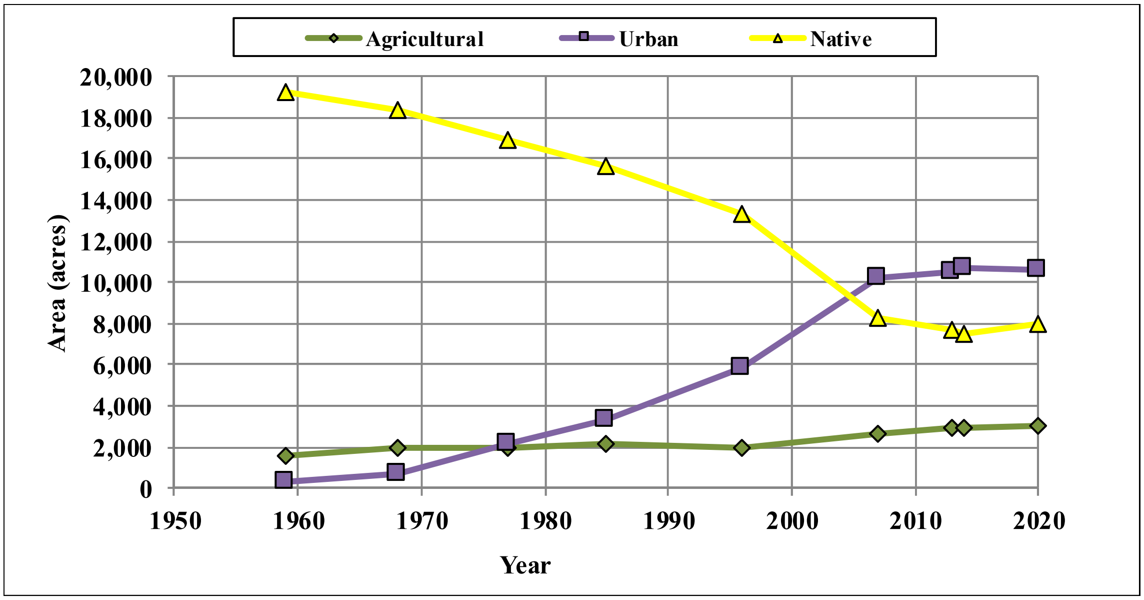

Figure 7-3. NMMA Land Use – 1959 to 2020

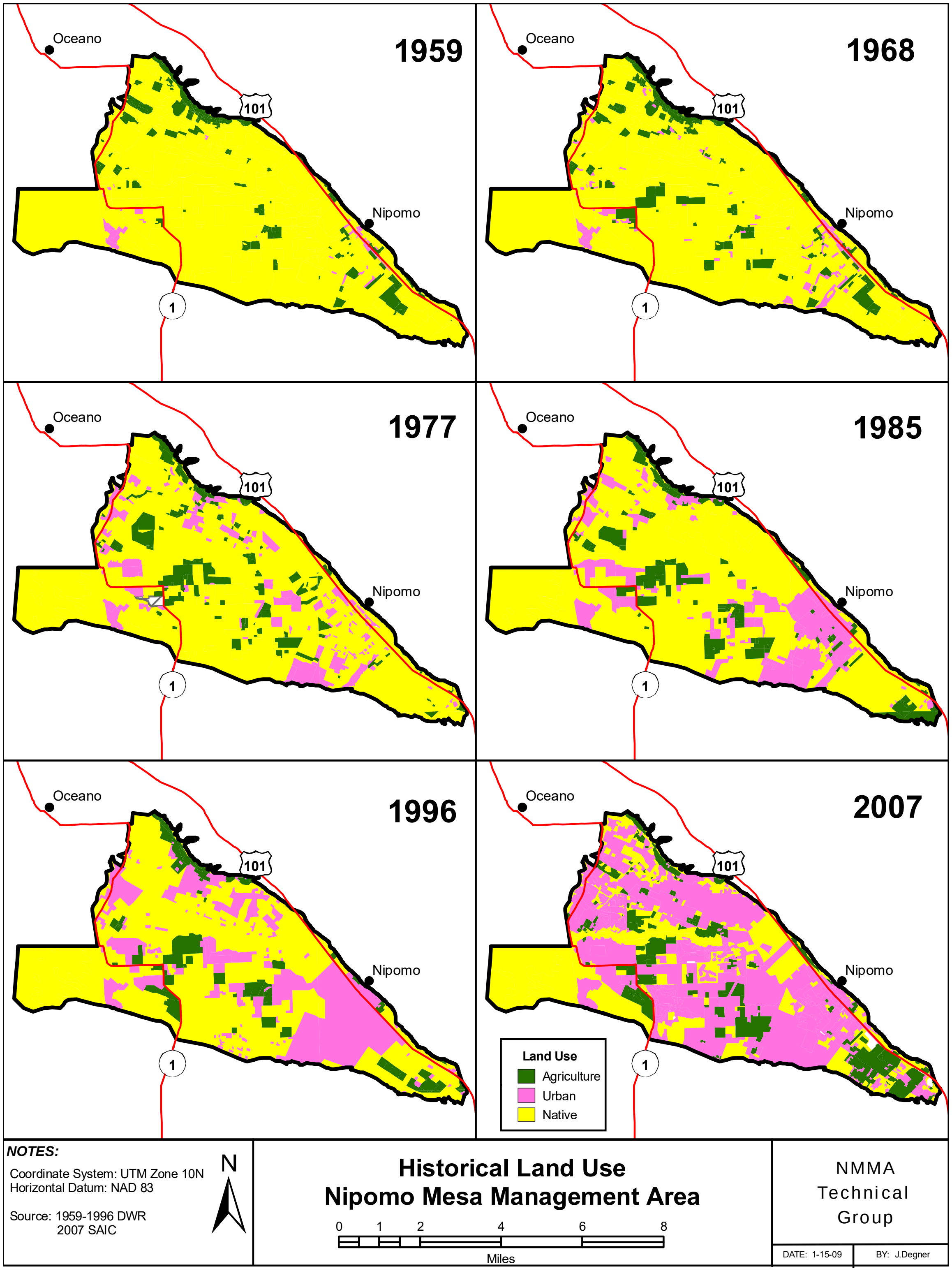

Figure 7-4. Historical Land Use in the NMMA

8. Other Considerations

8.1. *Institutional or Regulatory Challenges to Water Supply*

Several types of entities and individual landowners extract water from aquifers underlying the NMMA to meet water demands and no single entity is responsible for the delivery and management of available water supplies. Each entity must act in accordance with the powers and authorities granted under California law.

The powers and authorities for Woodlands and NCSD are set forth in the California Water Code. The CPUC regulates GSWC. This diversity of the public water purveyors' powers and the locations of their respective service areas (Figure 1-1) must be taken into account in attempting to develop consistent water management strategies that can be coupled with enforceable measures to ensure timely compliance with recommendations made by the TG, or mandatory Court orders. This is particularly true when there are legal requirements relating to the timing of instigating changes in water rates, implementation of mandatory water conservation practices, or forcing a change in pumping patterns, which may require one entity to deliver water to a location outside its service area.

A cooperative effort among the purveyors and other parties is the only expedient means to meet these institutional and regulatory challenges relating to the water supply and overall management of the NMMA. The purveyors developed a WMP in CY 2010 which outlines steps to take in "potentially severe water shortage conditions," as well as in "severe water shortage conditions" (see Appendix B). The WMP identifies a list of recommended water use restrictions to limit prohibited, nonessential and unauthorized water uses. For each condition, the WMP also identifies both voluntary and mandatory actions such as conservation goals, shifts in pumping patterns, and potential additional use and pumping restrictions.

9. Recommendations

A list of recommendations was developed and published in each of the previous NMMA Annual Reports. The TG will address past and newly developed recommendations, based on future budgets, feasibility, and priority. The recommendations are subdivided into two categories: (1) Achievements from earlier NMMA Annual Report recommendations accomplished in 2020, and (2) Technical Recommendations – to address the needs of the TG for data collection and compilation.

9.1. *Achievements from Previous NMMA Annual Report Recommendations*

The TG worked to address several of the recommendations outlined in the previous Annual Reports. Achievements made during 2020 are as follows:

- As part of the continued operation of the NSWP, a total of 1,041 AF of water was delivered to the NMMA during the CY 2020.

- A water level transducer and data logger were installed at one of the Key Wells (11N35W22C02) in late 2020.

- The TG continued review of the NMMA Monitoring Program to identify additional wells or monitoring points to include, in an effort to better characterize conditions in the shallow aquifer and to fill geographic data gaps associated with shallow and deep aquifers. The TG also approached and coordinated with SLO County, which resumed semi-annual monitoring of groundwater levels at a previous Key Well (11N35W23L01).

- To support certain estimates of groundwater production, the TG updated the classification of land use in the NMMA, which was last categorized in 2014, based on 2020 conditions.

- The TG continued tracking, in part through regular communication with San Luis Obispo County, groundwater management activities in groundwater basins adjacent to the SMGB upgradient of the NCMA. These activities are being implemented within the Arroyo Grande subbasin under the umbrella of California's Sustainable Groundwater Management Act.

- To better support evaluation of the potential for seawater intrusion, this report includes ion ratio time-series data for certain coastal wells and charts of ion ratio time-series data for other coastal wells.

9.2. *Technical Recommendations*

The following technical recommendations are not organized in order of priority, because the monitoring parties, considering their own particular funding constraints and authorities, will determine the implementation strategies and priorities.

- **Supplemental Water Supplies –** Reducing pumping is the most effective method to reduce the stress on the aquifers and to allow groundwater to recover; continued operation of the NSWP (see Section 1.1.5-Supplemental Water) is another viable method to achieve these goals. The TG recommends that this project continue to be implemented consistent with the Judgment and Stipulation.

- **Subsurface Flow Estimates –** Evaluate subsurface flow along the NMMA boundaries based on groundwater gradients and hydraulic conductivities in the shallow and deep aquifers.

- **Key Wells Monitoring –** Where possible, install data loggers in all Key Wells.

- **Key Wells Index 5-Year Review –** Evaluate and review the Key Wells Index by 2025.

- **Monitoring Points –** Replace the lost monitoring wells near Oso Flaco Lake. Select specific shallow dune sand aquifer wells for groundwater monitoring.

- **Well Reference Point Elevations –** Continue to improve the accuracy of the RP elevations using LIDAR data and other survey data.

- **Groundwater Production –** Develop a method to collect groundwater production data from all stipulating parties. Continue to update the land use classification on an interval commensurate with significant changes in land use patterns and as is practical, with the intention that the interval is more frequent than DWR's 10-year cycle of land use classification.

- **Agricultural Groundwater Production –** Continue to work with NMMA area farmers to measure groundwater production. Continue consultation with San Luis Obispo County Agriculture Department and other local experts in crop water use with specific updates to emerging crops and crop conversions.

- **Hydrogeologic Characteristics of NMMA –**Continue to review well screen intervals, lithology, groundwater level, and other relevant information. Improve the understanding of NMMA area fault displacements and potential effects of faulting on the hydrostratigraphy and groundwater flow in the NMMA.

- **Stream Flow Estimates –** Develop rating curves for Los Berros Creek, and install a new stream sensor on Nipomo Creek and develop a rating curve.

- **Groundwater Modeling –** Continue to engage with users utilizing the regional groundwater model developed for Pismo Beach and the South SLO County Sanitation District to assess efforts to revise and update the accuracy of the model.

- **SGMA –** Continue communication between the TG and SLO County with respect to the County's groundwater management activity adjacent to the adjudicated portion of the SMGB. The TG will continue to report annual groundwater conditions to the DWR SGMA reporting site for adjudicated basins.

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Appendices

Appendix A: Monitoring Program

Nipomo Mesa Monitoring Program

Prepared by

Nipomo Mesa Management Area Technical Group

August 2008

Table of Contents

1 INTRODUCTION

1.1 Background

This Monitoring Program is a joint effort of the Nipomo Mesa Management Area ("NMMA") Technical Group ("Technical Group"). The Technical Group was formed pursuant to a requirement contained in the 2005 Stipulation ("Stipulation") for the Santa Maria Basin Adjudication. Sections IV D (All Management Areas) and Section VI (C) (Nipomo Mesa Management Area) contained in the Stipulation were independently adopted by the Court in the Judgment After Trial[1] (herein "Judgment"). The Monitoring Program is a key component of the portions of the Judgment that involve the NMMA and forms the basis for subsequent analyses of the basin to be included in Annual Reports for the NMMA.

This Monitoring Program includes a discussion of the various parameters to be monitored within the NMMA, and a discussion of data analysis methods and water shortage triggers. The Monitoring Program provides a permanent foundation for the type of information to be regularly monitored and collected. However, the Technical Group is expected periodically to evaluate and update the Monitoring Program to ensure it provides comprehensive information sufficient to assess the integrity of water resources within the NMMA. For example, the Technical Group may change or expand monitoring points or types of data to be collected and otherwise periodically amend the Monitoring Program. Material amendments will be submitted for court approval.

1.2 Judgment

As a component of the physical solution for the Santa Maria groundwater basin, the Judgment requires the development and implementation of comprehensive monitoring and reporting in each of three Management Areas in the basin – Northern Cities Management Area, Nipomo Mesa Management Area, and Santa Maria Valley Management Area (Figure 1). For each of these Management Areas the Judgment specifies:

"A Monitoring Program shall be established in each of the three Management Areas to collect and analyze data regarding water supply and demand conditions. Data collection and monitoring shall be sufficient to determine land and water uses in the Basin, sources of supply to meet those uses, groundwater conditions including groundwater levels and quality, the amount and dispositions of Developed Water supplies, and the amount and disposition of any sources of water supply in the Basin.

[1] The Judgment is dated January 25, 2008 and was entered and served on all parties on February 7, 2008. This Monitoring Program is to be submitted for court approval on or before August 6, 2008.

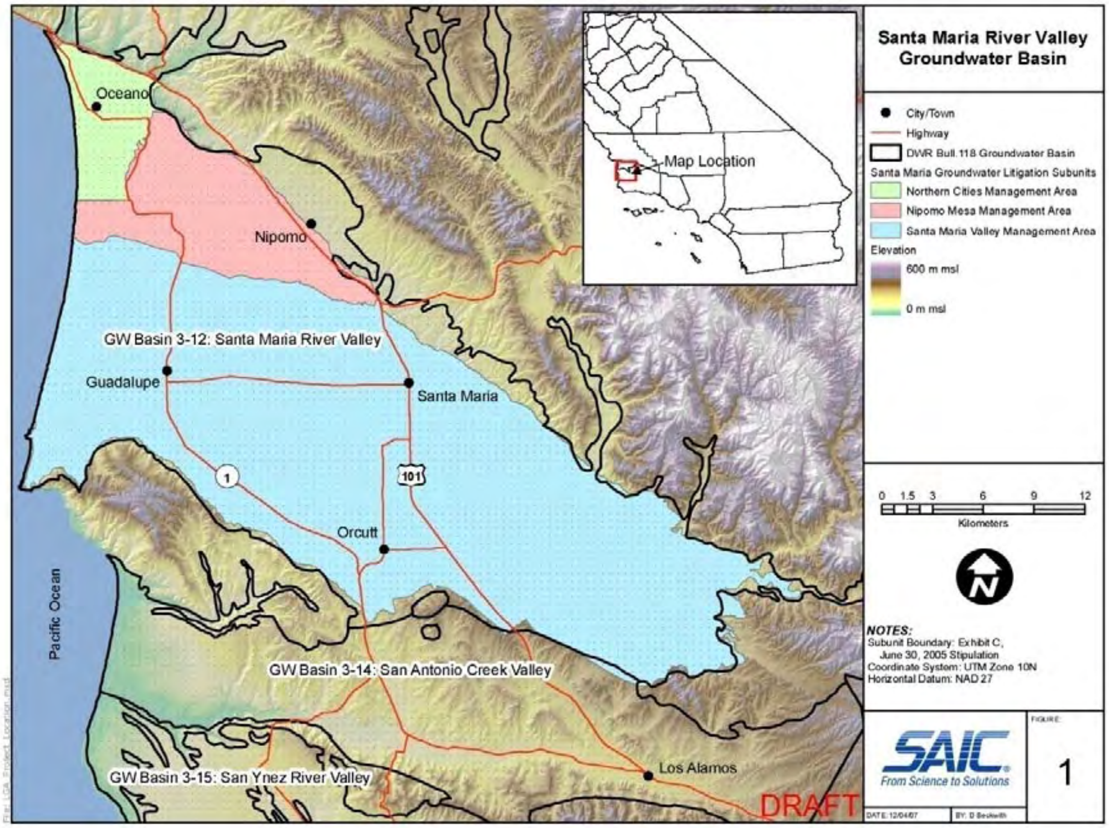

Figure 1. Santa Maria groundwater basin location map.

Within one hundred and eighty days after entry of judgment, representatives of the Monitoring Parties from each Management Area will present to the Court for its approval their proposed Monitoring Program."

The Judgment also requires the NMMA and the Santa Maria Valley management area technical committees to submit for court approval the criteria that trigger responses to "potentially severe and severe shortage conditions" that are specified in the Judgment.

An additional requirement of the Judgment is an Annual Report:

"Within one hundred and twenty days after each Year, the Management Area Engineers will file an Annual Report with the Court. The Annual Report will summarize the results of the Monitoring Program, changes in groundwater supplies, and any threats to Groundwater supplies. The Annual Report shall also include a tabulation of Management Area water use, including Imported Water availability and use, Return Flow entitlement and use, other Developed Water availability and use, and Groundwater use. Any Stipulating Party may object to the Monitoring Program, the reported results, or the Annual Report by motion."

Each Management Area Monitoring Plan will provide the basis for the preparation of the annual reports and the data to support the evaluations for the potentially severe and severe water shortage conditions relevant to the NMMA and the Santa Maria Valley management area.

1.3 Technical Group

The NMMA Technical Group is designated as the Monitoring Party for the NMMA.

Membership

The NMMA Technical Group is designated in the Judgment as including representatives appointed by Nipomo Community Services District, Southern California Water Company (now known as Golden State Water Company), ConocoPhillips, Woodlands Mutual Water Company, and an agricultural overlying owner who is also a Party to the Stipulation. The service areas of purveyors in the Technical Group are indicated in Figure 2.

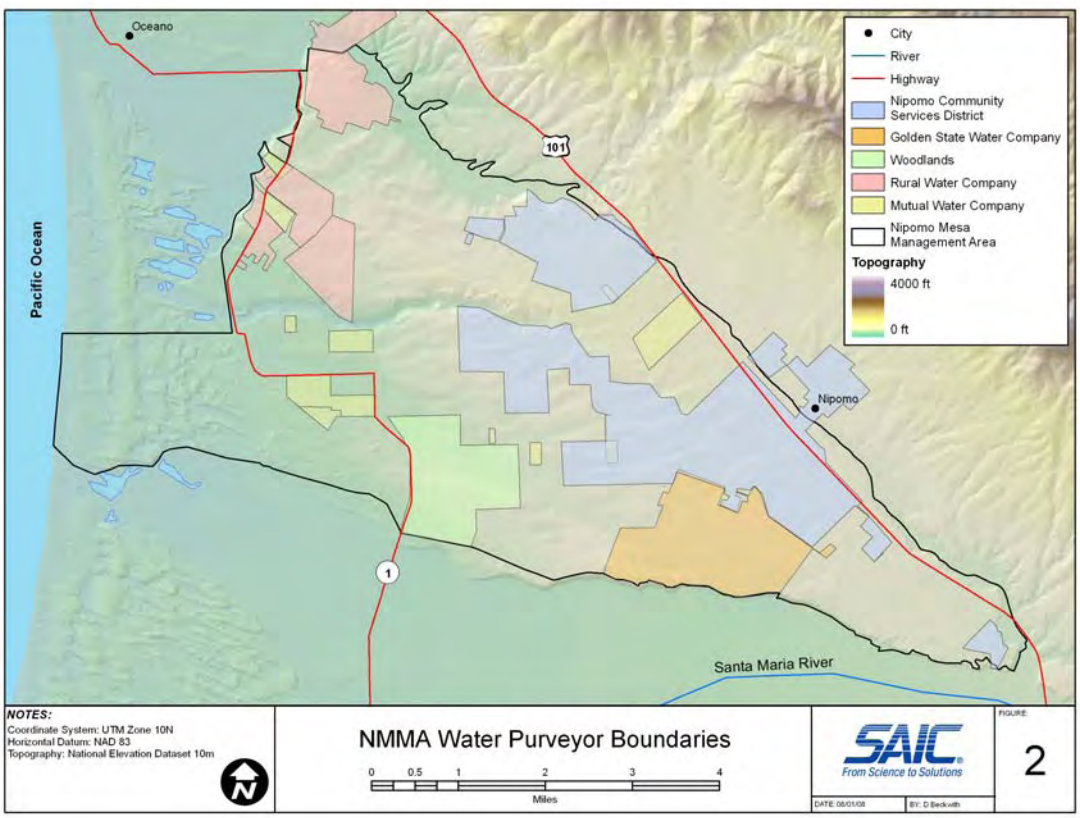

Figure 2. Water purveyors within the NMMA.

Role

The Technical Group is responsible for preparing the Monitoring Program, conducting the Monitoring Program, and preparing the Annual Reports. The Technical Group may hire individuals or consulting firms to assist in the preparation of the Monitoring Program and Annual Reports (the Judgment describes these individuals or consulting firms as the "Management Area Engineer"). The Technical Group has the sole discretion to select, retain, and replace the Management Area Engineer.

To assist the Technical Group in monitoring and analyzing water conditions in the NMMA, Stipulating Parties are required to provide monitoring and other production data at no charge, to the extent that such data have been generated and are readily available. The Technical Group is required to adopt rules and regulations concerning measuring devices that are consistent with the Monitoring Programs of other Management Areas when feasible.

If the Technical Group is unable to agree on any aspect of the Monitoring Program, the matter may be taken to the Court for resolution.

Cost Sharing

The Technical Group functions are to be funded by contribution levels negotiated by Nipomo Community Services District, Golden State Water Company, Rural Water Company, ConocoPhillips, and Woodlands Mutual Water Company. In-lieu contributions through engineering services may be provided, subject to agreement by those parties. The budget of the Technical Group shall not exceed $75,000 per year without prior approval of the Court.

1.4 Objectives Of Monitoring Program

The objectives of the Monitoring Program are to establish appropriate data collection criteria and analytical techniques to be used within the NMMA so that groundwater conditions, changes in groundwater supplies, threats to groundwater supplies, water use, and sources of water can be documented and reported on an annual basis. In addition, data developed through the Monitoring Program will be relied upon to provide the criteria for potentially severe and severe water shortage conditions.

1.5 Reporting Requirements

The Monitoring Program shall be presented for Court approval consistent with the Judgment. The Annual Report shall be submitted to the Court by April 30 of each year (April 29 on leap years).

2 MONITORING PARAMETERS

To satisfy the objectives of the Monitoring Program (section 1.4), data need to be collected from a variety of sources. The data to be collected include:

- Groundwater elevations measured in wells
- Water quality measured in wells
- Precipitation
- Streamflow
- Surface water usage
- Surface water quality
- Land use to the extent differential uses impact the NMMA water budget
- Groundwater pumping (measured)
- Groundwater pumping (estimated)
- Wastewater discharge and reuse amounts and locations

2.1 Groundwater Elevations

The San Luis Obispo County Department of Public Works, the U.S. Geological Survey, the California Department of Water Resources, and some groundwater users within the NMMA periodically gather groundwater elevation data on a large number of wells within the NMMA. Various members of the NMMA Technical Group already maintain these data in digital databases.

Current monitoring of groundwater elevations is conducted primarily by the County of San Luis Obispo, and additionally by Nipomo Community Services District, ConocoPhillips, Woodlands, Golden State Water Company, and Rural Water Company. The Monitoring Program will include compilation of groundwater elevations for a large number (93 initially) of groundwater wells located throughout the NMMA. Typically, groundwater elevations are measured during the fall and spring of each year. The initial list of the wells to be included in the Monitoring Program are shown in the Appendix.

The extensive current monitoring of groundwater elevations within the NMMA is sufficient to provide initial information on groundwater trends. However, there are four additional issues that the Technical Group will consider for further monitoring or analysis over the first years of implementation of the Monitoring Program:

- Additional existing coastal nested monitoring wells will be considered for inclusion in the groundwater elevation monitoring program. These include the 13K2-K6 nested site near Oso Flaco Lake (currently not being monitored) and the 36L1-L2 nested site in the coastal dunes west of Black Lake Canyon (outside the NMMA, currently monitored for groundwater elevations by SLO County).

- The wells used in the Monitoring Program will be investigated as necessary to ensure that the aquifer penetrated by the wells is verified.

- Additional wells may be added as necessary to the Monitoring Program in a phased approach to fill in data gaps recognized during preparation of the Annual Reports.

- The Technical Group may recommend that additional dedicated monitoring well(s) need to be installed at critical locations where no other information is available.

2.2 Groundwater Quality

As an element of compliance with their drinking water reporting responsibilities, public water purveyors within the NMMA have historically gathered and reported groundwater quality data (filed with the California Department of Public Health). In addition, the U.S. Geological Survey, the California Department of Water Resources, and SLO County have also gathered some water quality data within the NMMA. Members of the NMMA Technical Group maintain these data in digital databases.

Of considerable importance is groundwater quality in wells near the ocean, the most likely site where any intrusion of seawater would first be detected. Because there was no current monitoring of groundwater quality in any of the coastal nested monitoring wells, the Monitoring Program will include the following:

- Coastal nested monitoring well site 11N/36W-12C (west of the ConocoPhillips refinery) is now monitored under agreement with SLO County and provides quarterly water quality sampling. Samples are collected for chloride, sulfate, and sodium lab analyses and pH, EC, and temperature are measured in the field.

Regular sampling and analyses of groundwater quality is an important component of the Monitoring Program, because of the potential threat of seawater intrusion at the coastline and potential water quality changes caused by pumping stress in other portions of the NMMA and the basin as a whole. Water quality does not change as rapidly as groundwater elevations, so quality monitoring does not have to be as frequent. With the addition of the coastal nested monitoring data, current water quality monitoring appears to be adequate. However, four aspects of the Monitoring Program will be further evaluated to ensure the ongoing adequacy of the Monitoring Program:

- The Technical Group will arrange to receive water quality monitoring results from purveyors within the NMMA, either directly from the purveyors or annually from the Department of Public Health.

- Coastal nested monitoring well site 12C will be evaluated to determine whether current quarterly sampling can be reduced in frequency (or field testing substituted for laboratory analysis), thus allowing funding for water quality monitoring of additional nested site 13K2-K6 near Oso Flaco Lake (not sampled for three decades) and the 36L1-L2 nested site in the coastal dunes west of Black Lake Canyon (last sampled 12 years ago).

- Each well used for monitoring of groundwater elevations will be tested once for general minerals (if such testing is not already conducted) as budgeting allows. This testing will help further define particular aquifer characteristics.

- A water quality monitoring contingency plan will be developed in the event that there are indications of seawater intrusion in coastal monitoring wells. This contingency plan will consider triggers for increased sampling, both in frequency and in added analytes (e.g., iodide, strontium, boron, oxygen/hydrogen isotopes).

2.3 Precipitation

There is a wide choice of existing precipitation stations that can be used to estimate rainfall within the NMMA. Two gauges are part of the ALERT Storm Watch System, Nipomo East (728) and Nipomo South (730). Other gauges include Simas (201.1), Black Lake (222), Runels Ranch (42.1), Oceano Wastewater Plant (194), Nipomo Mesa (152.1), Peny Ranch (175.1), Mehlschau (38), NCSD Shop (223), Nipomo CDF (151.1), and CIMIS Nipomo #202 Station. As part of the analysis for the Annual Reports, data from an appropriate subset of these gauges will be used to estimate precipitation each year.

2.4 Streamflow

Streamflow can be important both as an input and an output of the water balance for an area. Currently, streamflow within the NMMA is partially gauged. The Los Berros Creek gauge (Sensor 757) is located 0.8 miles downstream from Adobe Creek and 3.7 miles north of Nipomo on Los Berros Road. This station is located approximately where Los Berros Creek conveys water out of the NMMA.

Nipomo Creek is not currently being monitored and is observed to convey water out of the NMMA during some of the year. The Technical Group will consider whether monitoring of Nipomo Creek or any other surface water monitoring is necessary or appropriate.

2.5 Surface Water Quality and Usage

There has been limited surface water monitoring of the dune lake complex and in Black Lake Canyon by the San Luis Obispo Land Conservancy and others. The

Technical Group will evalute whether this monitoring is sufficient and will obtain this and any additional related data as necessary and appropriate.

It is not known whether there are surface water diversions within the NMMA. The Technical Group will investigate this issue and determine whether additional monitoring is necessary and appropriate.

2.6 Land and Water Uses Impacting NMMA Water Balance

Land uses within the NMMA include agricultural, residential/commercial, and undeveloped areas. Land use surveys can be useful both in developing an overall water balance assessment and as an aide to estimate water use when such use is not directly measured. The most common method of conducting a land use survey is to obtain current digital aerial photography, classify the land uses, and create GIS mapping of the various land use classifications. In some cases, field checking is also required to confirm information obtained from aerial photography.

Where necessary, water use may be established based on the various types of land use within the NMMA. Information may be obtained from both published data (including San Luis Obispo County WPA-6) and any information compiled from existing stations installed in and around the NMMA that monitor climate data (CIMIS). This is described in greater detail in Section 2.8.

2.7 Groundwater Pumping (Measured)

Individual landowners, public water purveyors, and industry all rely on groundwater pumping from the NMMA. To the extent users measure their volume of use, these data will be reported to the Technical Group on an annual basis. Stipulating Parties to the Judgment are required to provide monitoring and other production data at no charge, to the extent that such data have been generated and are readily available.

Pursuant to paragraph 5 of the Judgment, the Technical Group retains the right to seek a Court Order requiring non-stipulating parties to monitor their well production, maintain records thereof, and make the data available to the Court or the Court’s designee.

2.8 Groundwater Pumping (Estimated)

Some groundwater users do not measure the volume of their groundwater production, and thus, this increment of groundwater pumping will have to be estimated each year. There are several methods of estimating groundwater pumping when totalizing meters are not installed. For cooperating pumpers, electrical records for pumping can be used, with the most accuracy obtained when the wells are tested regularly for pump efficiency.

Another method of estimating agricultural pumping is through self-reporting or surveys of crop type and irrigated acreage. For agriculture, water use can then be estimated using calculations that include crop water demand, effective precipitation, evapotranspiration, irrigation efficiency, and leaching requirements. An active California Irrigation Management Information System (CIMIS) station is located in the southern portion of the Woodlands within the NMMA and provides a useful reference for Nipomo Mesa evapotranspiration. A second active station is located adjacent to the Sisquoc River, above Tepusquet Creek.

For municipal or mixed rural lands, estimates will be based on acreage and development type. In some urban lands, a "unit water use" can be derived from average water consumption recorded from comparable or historical conditions.

To develop a complete picture of groundwater withdrawals for Nipomo Mesa, the Technical Group will develop methods for estimating unmetered groundwater pumping that will likely include some combination of those discussed above.

2.9 Wastewater Discharge and Reuse

Four wastewater treatment facilities discharge treated effluent within the NMMA and include the following: NCSD's Southland Wastewater Treatment Facility in the eastern portion of Nipomo Mesa, NCSD's wastewater treatment plant at Blacklake Village, Cypress Ridge's wastewater treatment facility, and the Woodland's wastewater treatment facilities. The Monitoring Program will include an annual compilation of wastewater treatment plant discharges, any reuse of the treated water (quantities and locations), and available water quality parameters.

3 DATA ANALYSIS & WATER SHORTAGE TRIGGERS

The primary purpose of the Monitoring Program is to detect changes in groundwater conditions that indicate current and future water supply problems within the NMMA. Although the determination of methods of data analysis and subsequent triggers that can indicate negative water supply conditions are not elements of the Monitoring Program, initial assessment of these issues are the responsibility of the Technical Group. A short discussion of potential methodologies follows.

3.1 Data Analysis

The focus of data analysis is to help detect and predict whether any conditions exist that could harm the aquifer, either by excessive drawdown or by degrading water quality. In evaluating the Monitoring Program data, the Technical Group will establish methodologies to use monitoring data to define the "health" of the basin. Among the methodologies that the Technical Group will evaluate in developing potentially severe and severe water shortage triggers are:

- **Coastal monitoring wells –** trends in water quality and groundwater elevations. Establish criteria to recognize both the potential for seawater intrusion and evidence of actual seawater intrusion.

- **Coastal groundwater gradient –** the direction and magnitude of groundwater flow either towards the ocean or in a landward direction. Establish criteria to recognize conditions that could cause seawater intrusion.

- **NMMA-wide groundwater elevation contouring –** establish groundwater flow directions, detect areas of increased drawdown, determine how pumping patterns are affecting the basin and the effects of any changes in the location of pumping that may serve to mitigate negative impacts.

- **Key wells –** indicator wells in key areas that track changes in groundwater elevations and water quality. Establish criteria to determine whether monitored changes could potentially be harmful to the aquifers.

- **Groundwater in storage –** calculation of changes of groundwater in storage and consideration of changes of groundwater storage over time can be used to analyze trends in the basin hydrologic balance.

3.2 Water Shortage Triggers

The Stipulation requires that water level and water quality criteria are to be established that will trigger responses to potential water shortages (the potentially severe and severe water shortage conditions). The Technical Group will rely on the Monitoring Program data and protocol in establishing the proposed criteria for these triggers. The triggers points will be presented for court approval, as required in the Stipulation, prior to or concurrent with the filing of the first Annual Report in 2009. Annual Reports will include an assessment of basin conditions relative to the proposed trigger points.

APPENDIX – MONITORING POINTS

The monitoring points shown on Figure A-1 and in Table A-1 are the 93 initial wells that the NMMA Technical Group determined would provide information to evaluate the health of the Nipomo Mesa portion of the Santa Maria basin. Many of the wells indicated are currently being monitored (see Table A-1), with the remainder planned to be monitored prior to preparation of the first Annual Report.

As discussed in the main text of this Monitoring Program, wells will be added and/or dropped in subsequent years as the basin is evaluated annually. The addition and/or subtraction of monitoring wells will be based on data gaps, areas of special concern that require more monitoring, and data redundancy. Information from some of the wells listed in Table A-1 that are monitored by the County of San Luis Obispo may not be available because of privacy concerns – this issue will be addressed prior to preparation of the first Annual Report.

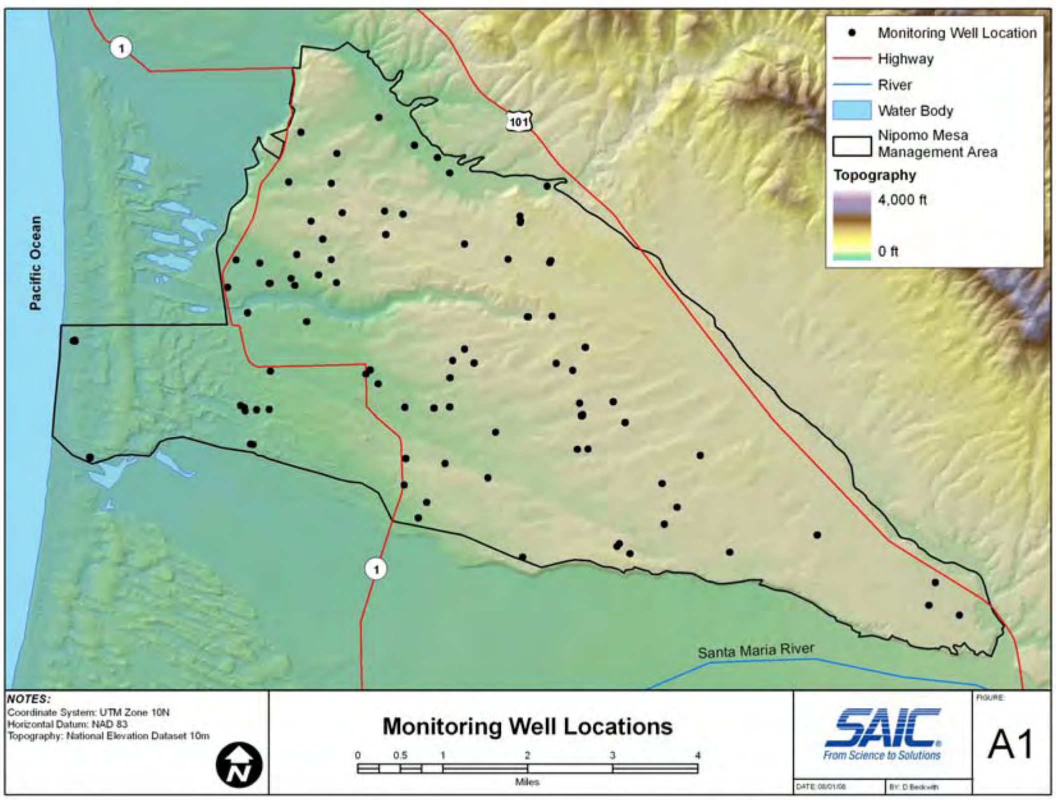

Figure A-1. Locations of monitoring points listed in Table A-1.

Appendix B: Water Shortage Conditions and Response Plan

Nipomo Mesa Management Area

Water Shortage Conditions and Response Plan

Nipomo Mesa Management Area
Technical Group

April 2009

The Santa Maria basin was divided into three management areas as a result of the adjudication of the Santa Maria groundwater basin. The June 30, 2005 Stipulation (“Stipulation”), the terms of which are incorporated into the Court's Judgment dated January 25, 2008 (“Judgment”), established the boundaries of the Nipomo Mesa Management Area (“NMMA”), and provided for a technical group (NMMA Technical Group) to oversee management of the NMMA. As part of the Stipulation, the Technical Group was tasked to develop a Monitoring Program that shall include the setting of well elevations and groundwater quality criteria that trigger the responses set forth in Paragraph VI(D) of the Stipulation.

The NMMA Technical Group prepared a Monitoring Program dated August 5, 2008 that was submitted to the Court in accordance with the Judgment. This Water Shortage Conditions and Response Plan is an addendum to the Monitoring Program and completes the Monitoring Program requirements as defined in the Stipulation.

This document is divided into three sections:

I. Water Shortage Conditions Nipomo Mesa Management Area,
II. Response Plan for Potentially Severe and Severe Water Shortage Conditions, and
III. Discussion of Criteria for Potentially Severe and Severe Water Shortage Conditions.

I. Water Shortage Conditions Nipomo Mesa Management Area

Water shortage conditions are characterized by criteria designed to reflect that groundwater levels beneath the NMMA as a whole are at a point at which a response would be triggered to avoid further declines in groundwater levels (Potentially Severe), and to declare that the lowest historic groundwater levels beneath the NMMA as a whole have been reached or that conditions constituting seawater intrusion have been reached (Severe).

Groundwater levels beneath the NMMA as a whole impact the cost of pumping, the quality of groundwater pumped, and the overall flow of fresh water to the ocean that balances potential seawater intrusion. Lowering of groundwater levels below certain thresholds is to be curtailed by importing supplemental water, increasing conservation, and decreasing consumptive use of groundwater produced.

The NMMA Technical Group has developed criteria for declaring the existence of Potentially Severe and Severe Water Shortage Conditions. These criteria represent the conditions in both coastal and inland wells, and depend upon measurements of groundwater elevation and groundwater quality.

While this Response Plan relies on quantitative measurements of groundwater levels, the Technical Group acknowledges these measurements are subject to many variables so that any given measurement may only be accurate within a percentage range; no given measurement is exact or precise. For example, water level measurements obtained from groundwater production wells may be influenced by a range of factors, including but not limited to temperature, the method, protocol, and equipment used to obtain the measurement, the condition of the well, the time allowed for water levels in a previously producing well to equilibrate, and any nearby wells that remain pumping while the measurements are taken. As well, the historic data used as the basis to set action levels for Severe and Potentially Severe Water Shortage Conditions may be influenced by these and other factors. Finally, while there is sufficient historical data to reliably set Severe and Potentially Severe Water Shortage Conditions criteria, as more data is gathered pursuant to the NMMA Monitoring Plan, the Technical Group expects its understanding of NMMA characteristics will become increasingly more sophisticated and accurate. As a result of these considerations, the Technical Group acknowledges and expects that it will recommend modifications to the Severe and Potentially Severe Water Shortage Conditions criteria as more data are obtained on a consistent basis and as the Technical Group's understanding of the NMMA characteristics improves over time.

Seawater intrusion is a condition that could permanently impair the use of the principal producing aquifer to meet water demands of the NMMA. For coastal areas, the criteria described here are set either to indicate conditions that, if allowed to persist, may lead to seawater intrusion or increasing chloride concentrations, or that actual seawater intrusion has occurred.

Monitoring Wells

As with the NMMA Monitoring Plan, primary data for this Water Shortage Conditions and Response Plan is derived from a select group of wells located within the NMMA. Identification of these wells and the selection criteria are as follows.

Coastal sentinel wells, installed by the Department of Water Resources in the 1960s, are monitored to characterize any condition for the advancement of seawater into the freshwater aquifer. Specifically, the groundwater elevation and concentration of indicator constituents are evaluated to determine the threat or presence of seawater intrusion to the fresh water aquifer. These coastal monitoring wells are as follows:

Coastal Well	Perforation Elevation (ft msl)	Aquifer
11N/36W-12C1	-261 to -271	Paso Robles
11N/36W-12C2	-431 to -441	Pismo
11N/36W-12C3	-701 to -711	Pismo
12N/36W-36L1	-200 to -210	Paso Robles
12N/36W-36L2	-508 to -518	Pismo

For inland areas, criteria for water shortage conditions are based on annual Spring groundwater elevation measurements made in key wells located inland from the coast (the "Key Wells Index"). The inland Key Wells are as follows:

Key Wells
11N/34W-19
11N/35W-5
11N/35W-8
11N/35W-9
11N/35W-13
11N/35W-22
11N/35W-23
12N/35W-33

Potentially Severe Water Shortage Conditions

The Stipulation, page 25, defines Potentially Severe Water Conditions as follows:

Caution trigger point (Potentially Severe Water Shortage Conditions)[1]

(a) Characteristics. The NMMA Technical Group shall develop criteria for declaring the existence of Potentially Severe Water Shortage Conditions. These criteria shall be approved by the Court and entered as a modification to this Stipulation or the judgment to be entered based upon this Stipulation. Such criteria shall be designed to reflect that water levels beneath the NMMA as a whole are at a point at

[1] The multiple citations to and partial restatements of the Stipulation are intended to provide context to this Water Shortage Conditions and Response Plan. However, neither the restatement of a portion of the Stipulation herein, nor the omission of a portion of a quotation from the Stipulation, is intended to override or alter the mutual obligations and requirements set forth in the Stipulation.

which voluntary conservation measures, augmentation of supply, or other steps may be desirable or necessary to avoid further declines in water levels.

Inland Areas: The NMMA Technical Group set the criteria for a Potentially Severe Water Shortage Condition to the elevation of groundwater as determined by the Key Wells Index. If the Spring groundwater elevations indicate that the Key Wells Index is less than 15 feet above the Severe Water Shortage criterion (equal to **31.5 ft msl**[2]**)**, the Technical Group will notify the Monitoring Parties of the current data, and evaluate the probable causes of this low level as described below. If the Key Wells Index continues to be lower than **31.5 ft msl** in the following Spring, the Technical Group will report to the Court in the Annual Report that Potentially Severe Water Shortage Conditions are present and provide its recommendations regarding the appropriate response measures. During the period a Potentially Severe Water Shortage Condition persists, the NMMA Technical Group shall include in each Annual Report an assessment of the hydrologic conditions and any additional recommended response measures. A discussion of how the groundwater elevations criteria were determined is presented in discussion Section III. Potentially Severe Water Shortage Conditions will no longer be considered to exist when: 1) the Key Well Index is above the Potentially Severe criterion of 31.5 ft msl for two successive Spring measurements, or 2) the Key Well Index is 5 ft or higher above the Potentially Severe criterion (which calculates to 36.5 ft msl) in any Spring measurement. Alternatively, the NMMA Technical Group may determine that the Potentially Severe Water Shortage Condition no longer exists when the Key Well Index is above the Potentially Severe criterion of 31.5 ft msl and conditions warrant this conclusion.

The Key Well Index criteria for Potentially Severe Water Shortage Conditions may be modified in the future by the Technical Group as more data are developed on the accuracy of measured data and Key Well construction or condition.

Coastal Areas: The NMMA Technical Group set the coastal criteria for a Potentially Severe Water Shortage Condition using both groundwater surface elevation and groundwater quality measured in the coastal monitoring wells, as presented in the table below. The groundwater elevation criteria are discussed in Section III. The groundwater quality portion of the coastal criteria is set at **250 mg/L** chloride. There is no water quality criterion for the shallow alluvium. Potentially Severe Water Shortage Conditions are determined if either the Spring groundwater elevation drops below the criteria elevation, or chloride concentration exceeds the criteria concentration, in any of the coastal monitoring wells subject to the Response Plan data analysis and verification described below.

[2] The decimal point does not imply the accuracy of the historical low calculation.

The NMMA Technical Group will report to the Court in the Annual Report that Potentially Severe Water Shortage Conditions are present and provide its recommendations regarding the appropriate response measures. During the period a Potentially Severe Water Shortage Condition persists, the Technical Group shall include in each Annual Report an assessment of the hydrologic conditions and any additional recommended response measures.

When Spring groundwater elevations or groundwater quality subsequently improves so that the criteria threshold for two successive measurements are no longer exceeded, Potentially Severe Water Shortage Conditions will no longer be considered to exist. Alternatively, the Technical Group may determine that the Potentially Severe Water Shortage Condition no longer exists when the Spring groundwater elevation or groundwater quality criteria threshold are no longer exceeded in a single measurement and conditions warrant this conclusion.

The coastal threshold criteria for Potentially Severe Water Shortage Conditions may be modified in the future by the Technical Group as more data are developed on the accuracy and extent of the coastal data, including the potential for inclusion of additional coastal monitoring wells into the Monitoring Plan.

Criteria for Potentially Severe Water Shortage Conditions, Coastal Area

Well	Perforation Elevation (ft msl)	Aquifer	Elevation Criteria (ft msl)	Chloride Concentration Criteria (mg/L)
11N/36W-12C1	-261 to -271	Paso Robles	**5.0**	**250**
11N/36W-12C2	-431 to -441	Pismo	**5.5**	**250**
11N/36W-12C3	-701 to -711	Pismo	**9.0**	**250**
12N/36W-36L1	-200 to -210	Paso Robles	**3.5**	**250**
12N/36W-36L2	-508 to -518	Pismo	**9.0**	**250**

Severe Water Shortage Conditions

The Stipulation, page 25, defines Potentially Severe Water Conditions as follows:

Mandatory action trigger point (Severe Water Shortage Conditions)

(a) Characteristics. The NMMA Technical Group shall develop the criteria for declaring that the lowest historic water levels beneath the NMMA as a whole

have been reached or that conditions constituting seawater intrusion have been reached. These criteria shall be approved by the Court and entered as a modification to this Stipulation or the judgment to be entered based upon this Stipulation.

Inland Areas: A Severe Water Shortage Condition exists when the Key Wells Index is less than **16.5 feet msl**, using Spring groundwater elevation measurements. The Mandatory Response Plan will remain in effect until groundwater elevations as indicated by the Key Wells Index are 10 ft above the Severe criterion (which calculates to **26.5 feet msl**). Alternatively, the NMMA Technical Group may determine that the Severe Water Shortage Condition no longer exists when the Key Well Index is above the Severe criterion of 16.5 ft msl and conditions warrant this conclusion.

The criteria for Severe Water Shortage Conditions may be modified in the future by the Technical Group as more data are developed on the accuracy of measured data and Key Well construction or condition.

Coastal Areas: The NMMA Technical Group set the coastal criteria for Severe Water Shortage Condition to the occurrence of the chloride concentration in groundwater greater than the drinking water standard in any coastal monitoring well. Thus, the coastal criterion for a Severe Water Shortage Condition is the chloride concentration exceeding **500 mg/L** in any of the coastal monitoring wells. If the criterion is exceeded, an additional sample will be collected and analyzed from that well as soon as practicable to verify the result. The response triggered by the measurement will not be in effect until the laboratory analysis has been verified. If the chloride concentration subsequently improves above the criterion threshold for two successive Spring measurements, Severe Water Shortage Conditions will no longer be considered to exist. Alternatively, the Technical Group may determine that the Severe Water Shortage Condition no longer exists when groundwater quality criteria threshold are no longer exceeded in a single measurement and conditions warrant this conclusion.

The coastal threshold criteria for Severe Water Shortage Conditions may be modified in the future by the Technical Group as more data are developed on the accuracy and extent of the coastal data, including the potential for inclusion of additional coastal monitoring wells into the Monitoring Plan.

II. Response Plan for Potentially Severe and Severe Water Shortage Conditions

("Response Plan")

Introduction

This Response Plan is triggered by criteria designed to reflect either Potentially Severe Water Shortage Conditions or Severe Water Shortage Conditions. Nothing in this Response Plan is intended to, nor shall operate so as to reduce, limit or change the rights, duties, and responsibilities of the parties to this Response Plan as those rights, duties, and responsibilities are stated in the Stipulation and the Judgment.

1. Potentially Severe Water Shortage Conditions

The responses required by the Stipulation are set forth as follows:

VI(D)(1b) Responses [Potentially Severe]. *If the NMMA Technical Group determines that Potentially Severe Water Shortage Conditions have been reached, the Stipulating Parties shall coordinate their efforts to implement voluntary conservation measures, adopt programs to increase the supply of Nipomo Supplemental Water*[3] *if available, use within the NMMA other sources of Developed Water or New Developed Water, or implement other measures to reduce Groundwater use.*[4]

VI(A)(5). …In the event that Potentially Severe Water Shortage Conditions or Severe Water Shortage Conditions are triggered as referenced in Paragraph VI(D) before Nipomo Supplemental Water is used in the NMMA, NCSD, [GSWC[5]*], Woodlands and RWC agree to develop a well management plan that is acceptable to the NMMA Technical Group, and which may include such steps as imposing conservation measures, seeking sources of supplemental water to serve new customers, and declaring or obtaining approval to declare a moratorium on the granting of further intent to serve or will serve letters.*[6]

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[3] A defined term in the parties' Stipulation. The following terms, when used in this Response Plan, are terms whose definitions are found in the Stipulation and that definition is specifically incorporated herein and adopted as the meaning of these terms: "Developed Water," "Groundwater," "Native Groundwater," "New Developed Water," "Nipomo Supplemental Water," "Nipomo Supplemental Water Project," "Stipulating Parties" and "Year."

[4] Ibid at p.25.

[5] Name changed from Southern California Water Company (SCWC) in 2005.

[6] Ibid at p.22.

The Response Plan shall be implemented when the Potentially Severe Water Shortage Conditions occur within the NMMA. The Response Plan is a combination of technical studies to better determine the nature of the threat, water supply and demand actions to mitigate overall conditions in the NMMA, and compliance with the Stipulation and the Judgment. The Response Plan includes, where applicable, the following:

1. Coastal Groundwater Elevation and/or Groundwater Quality Conditions:
   a. Verify that the measurement is not an anomaly by retesting at the site(s) of exceedence as soon as practicable and again in the following month.
   b. Characterize the extent of either low groundwater elevation(s) or increased chloride concentration(s) near the coast, which might include adding and/or installing additional monitoring points.
   c. Identify, to the extent practical, factors that contributed to the low groundwater elevations in coastal monitoring wells.
   d. Investigate whether increased chloride concentration(s) indicate intrusion of seawater or other causes through chemistry/geochemistry studies.

2. Inland Groundwater Elevation Condition:
   a. Verify that the measurement is not an anomaly by retesting at the site(s) of exceedence as soon as practicable and again in the following month.
   b. Characterize the extent of the area where groundwater elevation(s) have decreased sufficiently to lower the Key Wells Index.
   c. Identify factors that contributed to the low groundwater elevation(s) in coastal monitoring wells.

3. Implement sections VI(D)1(b) and VI(A)(5) of the Stipulation, as reproduced above.

4. When either the groundwater quality or groundwater elevation conditions are confirmed, the following provisions apply to the Response Plan for Potentially Severe Water Shortage Conditions:

   a. ConocoPhillips shall have the right to the reasonable and beneficial use of Groundwater on the property it owns as of the date of the Stipulation located in the NMMA without limitation.[7]

[7] Ibid at p. 23.

b. Overlying Owners that are Stipulating Parties that own land located in the NMMA as of the date of the Stipulation shall have the right to the reasonable and beneficial use of Groundwater on their property within the NMMA without limitation.[8]

c. Woodlands shall not be subject to restriction in its reasonable and beneficial use of Groundwater, provided it is concurrently using or has made arrangements for other NMMA parties to use within the NMMA, the Nipomo Supplemental Water allocated to Woodlands. Otherwise, Woodlands shall be subject to reductions equivalent to those imposed on NCSD, GSWC, and RWC.[9]

2. Severe Water Shortage Conditions

The responses required by the Stipulation are set forth following:

VI(D)(1b) Responses [Severe]. *As a first response, subparagraphs (i) through (iii) shall be imposed concurrently upon order of the Court. The Court may also order the Stipulating Parties to implement all or some portion of the additional responses provided in subparagraph (iv) below.*

(i) For Overlying Owners other than Woodlands Mutual Water Company and ConocoPhillips, a reduction in the use of Groundwater to no more than 110% of the highest pooled amount previously collectively used by those Stipulating Parties in a Year, prorated for any partial Year in which implementation shall occur, unless one or more of those Stipulating Parties agrees to forego production for consideration received. Such forbearance shall cause an equivalent reduction in the pooled allowance. The base Year from which the calculation of any reduction is to be made may include any prior single Year up to the Year in which the Nipomo Supplemental Water is transmitted. The method of reducing pooled production to 110% is to be prescribed by the NMMA Technical Group and approved by the Court. The quantification of the pooled amount pursuant to this subsection shall be determined at the time the mandatory action trigger point (Severe Water Shortage Conditions) described in Paragraph VI(D)(2) is reached. The NMMA Technical Group shall determine a technically responsible and consistent method to determine the pooled amount and any individual's contribution to the pooled amount. If the NMMA Technical Group cannot agree upon a technically responsible and consistent method to determine the pooled amount, the matter may be determined by the Court pursuant to a noticed motion.

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[8] Ibid.

[9] Ibid at p. 23.

(ii) ConocoPhillips shall reduce its Yearly Groundwater use to no more than 110% of the highest amount it previously used in a single Year, unless it agrees in writing to use less Groundwater for consideration received. The base Year from which the calculation of any reduction is to be made may include any prior single Year up to the Year in which the Nipomo Supplemental Water is transmitted. ConocoPhillips shall have discretion in determining how reduction of its Groundwater use is achieved.

(iii) NCSD, RWC, SCWC, and Woodlands (if applicable as provided in Paragraph VI(B)(3) above) shall implement those mandatory conservation measures prescribed by the NMMA Technical Group and approved by the Court.

(iv) If the Court finds that Management Area conditions have deteriorated since it first found Severe Water Shortage Conditions, the Court may impose further mandatory limitations on Groundwater use by NCSD, SCWC, RWC and the Woodlands. Mandatory measures designed to reduce water consumption, such as water reductions, water restrictions, and rate increases for the purveyors, shall be considered.

(v) During Severe Water Shortage Conditions, the Stipulating Parties may make agreements for temporary transfer of rights to pump Native Groundwater, voluntary fallowing, or the implementation of extraordinary conservation measures. Transfer of Native Groundwater must benefit the Management Area and be approved by the Court.[10]

The following Response Plan for Severe Water Shortage Conditions is premised on the assumption that the Nipomo Supplemental Water Project within the NMMA is fully implemented and yet Severe Water Shortage Conditions exist.

If either the coastal or inland criteria occur for Severe Water Shortage Conditions within the NMMA, a Response Plan shall be implemented. The Response Plan is a combination of technical studies to better determine the nature of the threat, water supply and demand actions to mitigate overall conditions in the NMMA that triggered a Response Plan, and compliance with the terms of the Stipulation and the Judgment. It includes, where applicable, the following NMMA Technical Group actions:

1. Groundwater Quality Condition:
    a. Verify data.

[10] Ibid at pp. 25-27.

b. Investigate whether increased chloride concentration(s) indicate intrusion of seawater or result from other causes through chemistry/geochemistry studies.

c. Characterize the extent of the increase in chloride concentration(s), which may include adding additional monitoring points and/or installing new monitoring points.

d. Given information from sections (a) and (b) above, identify the factors that may have caused the groundwater quality degradation.

2. Groundwater Elevation Condition:

a. Verify that the measurement is not an anomaly by retesting at the site(s) of exceedence as soon as practicable and again in the following month.

b. Characterize the extent of the area where groundwater elevation(s) have decreased sufficiently to lower the Key Wells Index.

c. Identify the factors that contributed to the low groundwater elevation(s) in key wells.

3. As a first response, the NMMA Technical Group shall request the Court to order concurrently sections VI(D)(1b)(i) through (iii) of the Stipulation, as reproduced above.

4. Prepare a semi-annual report on the trend in chloride concentration for the Court. If chloride concentration(s) continue to increase at the coastline, request the Court to implement section VI(D)(1b)(iv) of the Stipulation, as reproduced above.

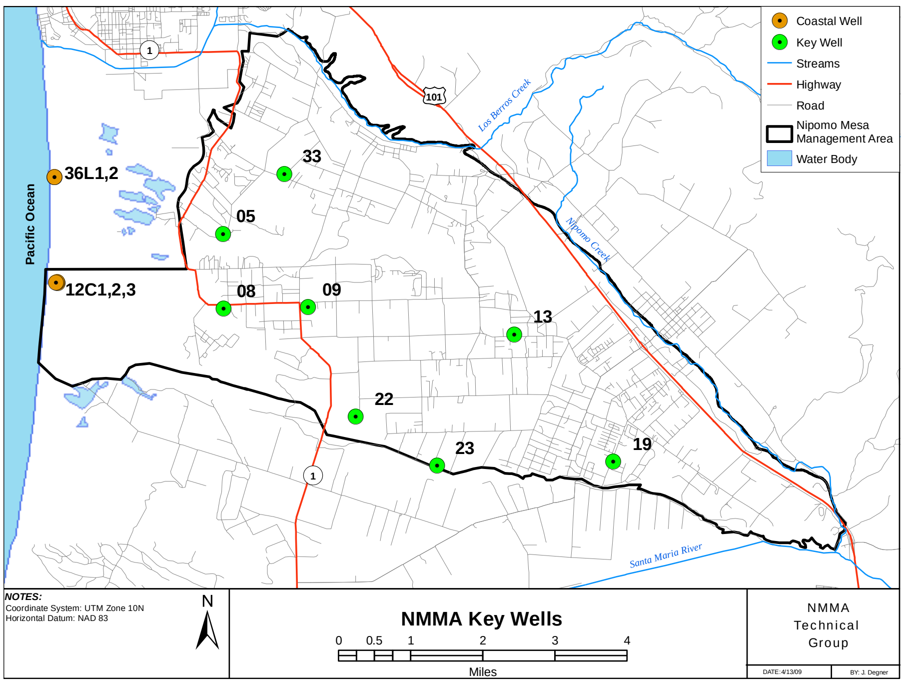
5. During Severe Water Shortage Conditions, the Stipulating Parties may make agreements for temporary transfer of groundwater pumping rights in accordance with section VI(D)(1b)(v) of the Stipulation, as reproduced above.

III. Discussion of Criteria for Potentially Severe and Severe Water Shortage Conditions

1. Water Shortage Conditions as a Whole

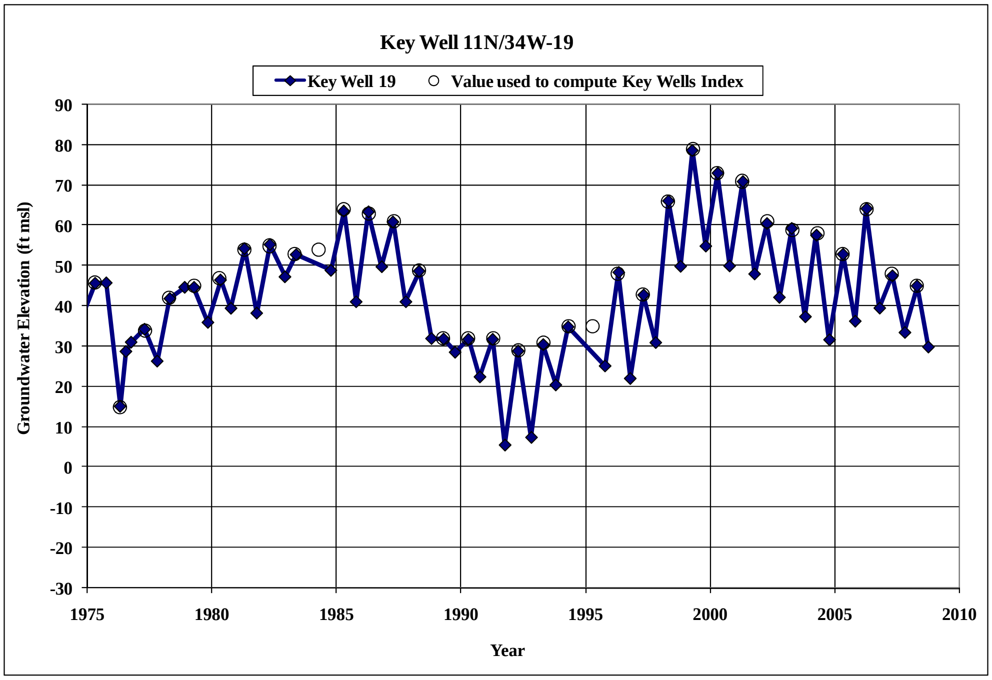
The Stipulation established that the Severe Water Shortage Conditions is characterized by the lowest historic groundwater levels beneath the NMMA as a whole. The NMMA Technical Group selected the data from eight inland key wells to represent the whole of the NMMA. These wells are listed in the following tabulation and are shown on the figure entitled "NMMA Key Wells". The average Spring groundwater elevation of these key wells is used to calculate the Key Wells Index ("Index").

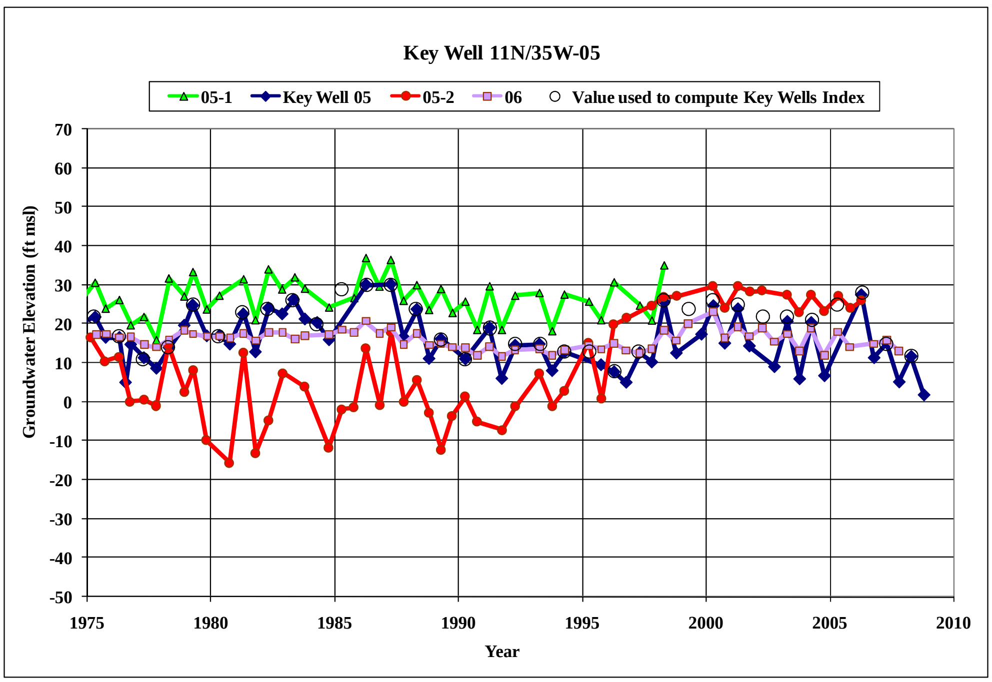
Key Wells For Inland Criterion
11N/34W-19
11N/35W-5
11N/35W-8
11N/35W-9
11N/35W-13
11N/35W-22
11N/35W-23
12N/35W-33

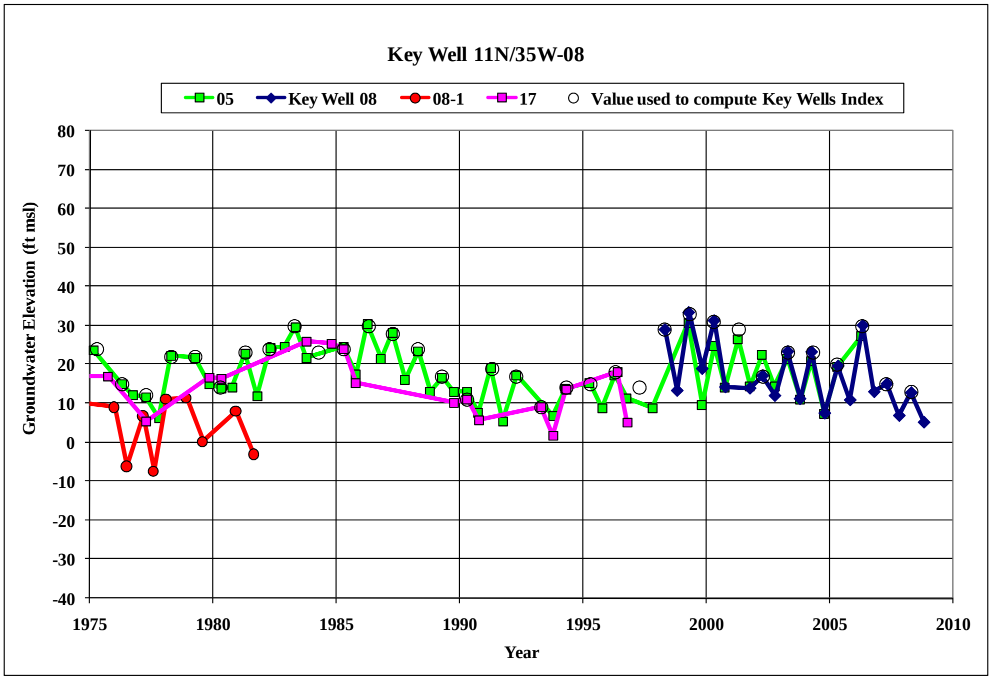


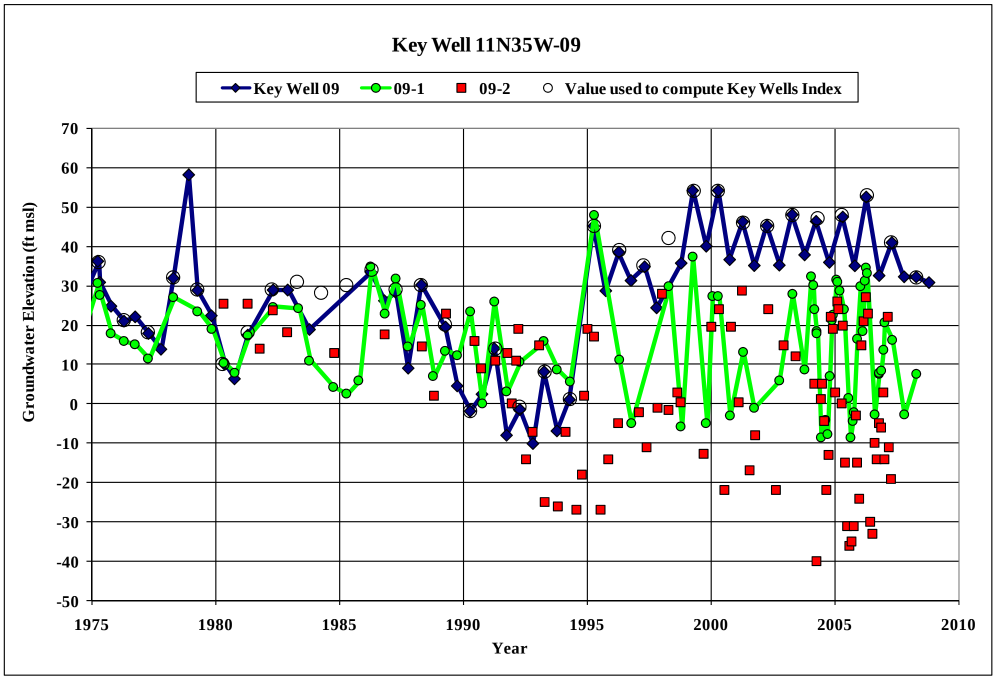
The Index was calculated annually using Spring groundwater elevation measurements from 1975 to 2008. The Key Wells were selected to represent various portions of the groundwater basin within the NMMA. The following charts display the hydrographs for each Key Well and surrounding wells. The open circles represent the actual Spring value for that year or a correlation of that value for each year that was used to compute the Index.

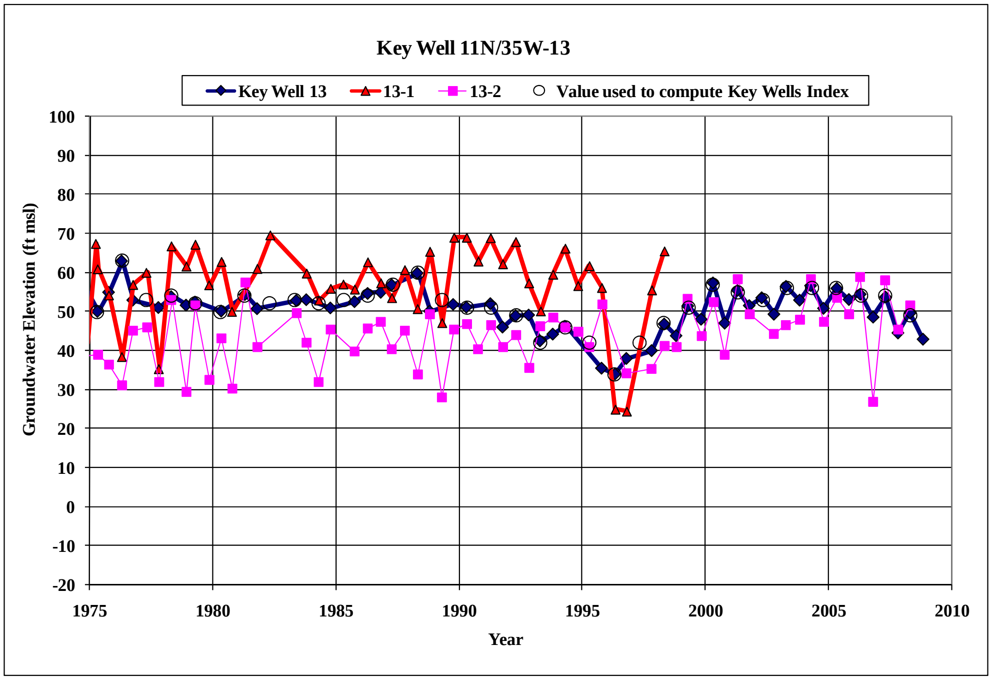
When there was no Spring groundwater elevation measurement for a particular year, the value was determined by either 1) interpolating between Spring measurements in adjacent years or 2) computing the Spring elevation by taking the Fall measurements in adjacent years and increasing the value by the typical increase in groundwater elevations between Spring and Fall measurements in that well. If there is a significant data gap in the record for a particular well (e.g., 22 well below), a nearby well was used to fill the gap.

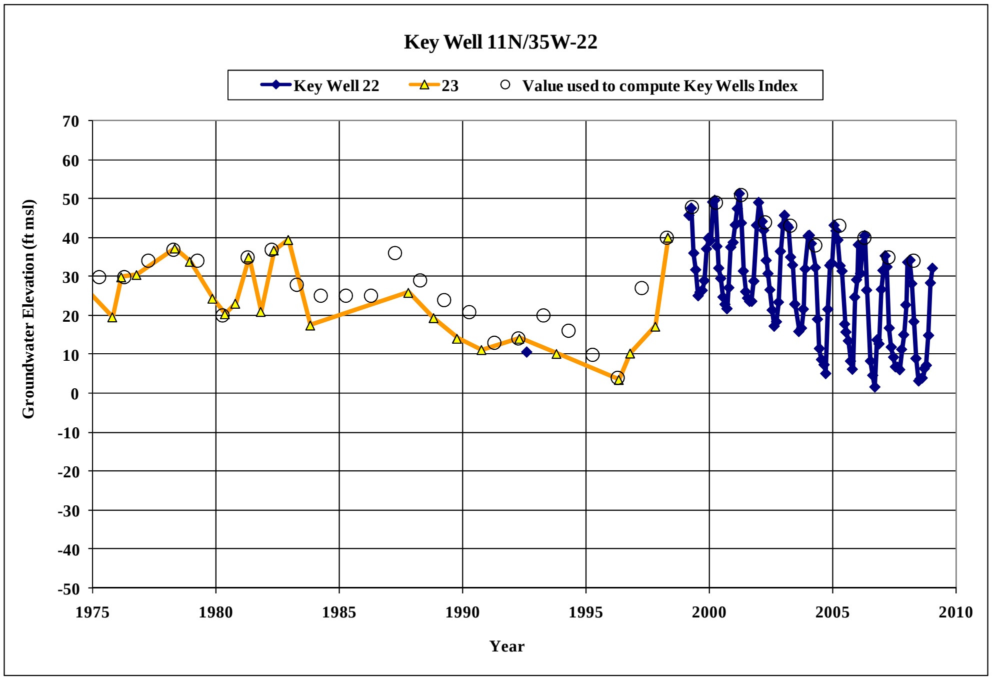


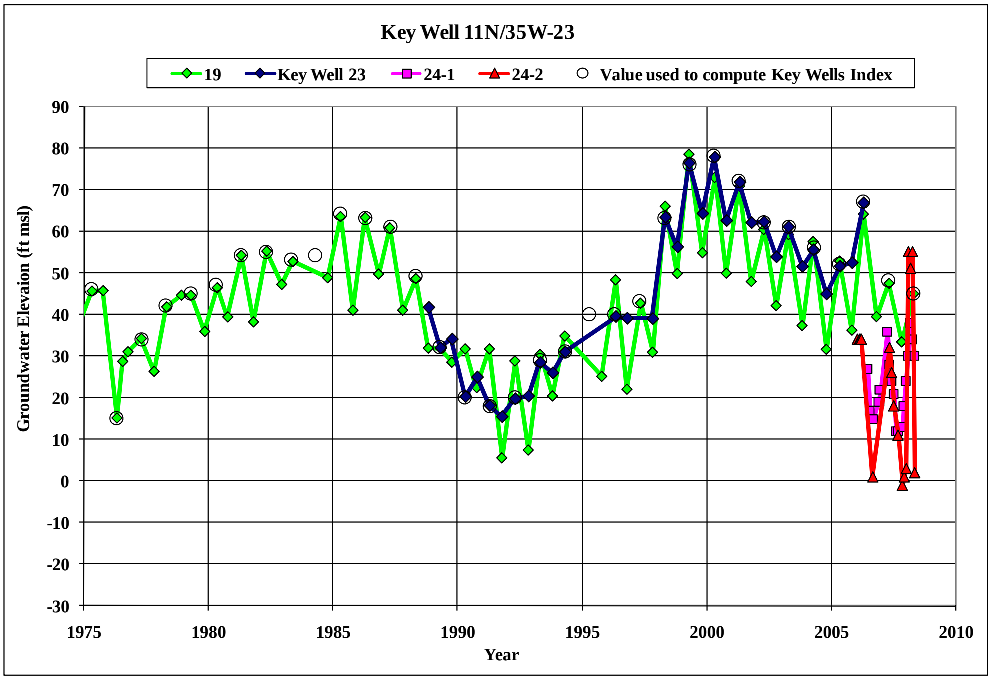


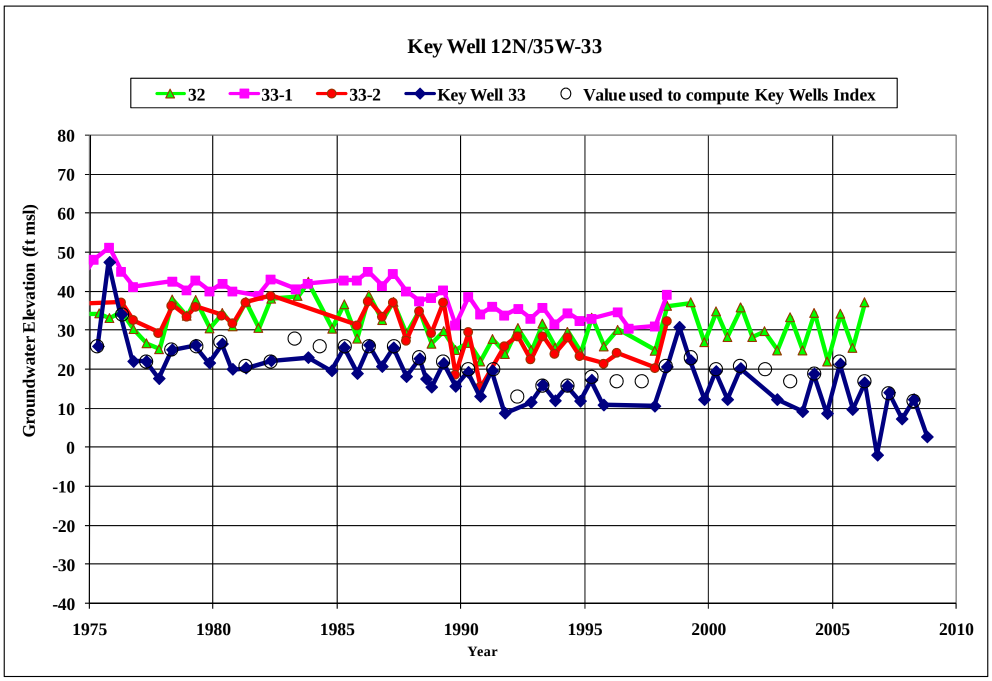

Key Well 11N/35W-08
05
Key Well 08
08-1
17
Value used to compute Key Wells Index
Groundwater Elevation (ft msl)
Year
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
1975
1980
1985
1990
1995
2000
2005
2010


Key Well 11N35W-09
Key Well 09
09-1
09-2
Value used to compute Key Wells Index
Groundwater Elevation (ft msl)
Year
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
1975
1980
1985
1990
1995
2000
2005
2010


Key Well 11N/35W-13
Key Well 13
13-1
13-2
Value used to compute Key Wells Index
Groundwater Elevation (ft msl)
100
90
80
70
60
50
40
30
20
10
0
-10
-20
1975
1980
1985
1990
1995
2000
2005
2010
Year


Key Well 11N/35W-22
Key Well 22
23
Value used to compute Key Wells Index
Groundwater Elevation (ft msl)
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
1975
1980
1985
1990
1995
2000
2005
2010
Year





In selecting the eight key wells, the following criteria were applied so that the wells generally represent the NMMA as a whole:

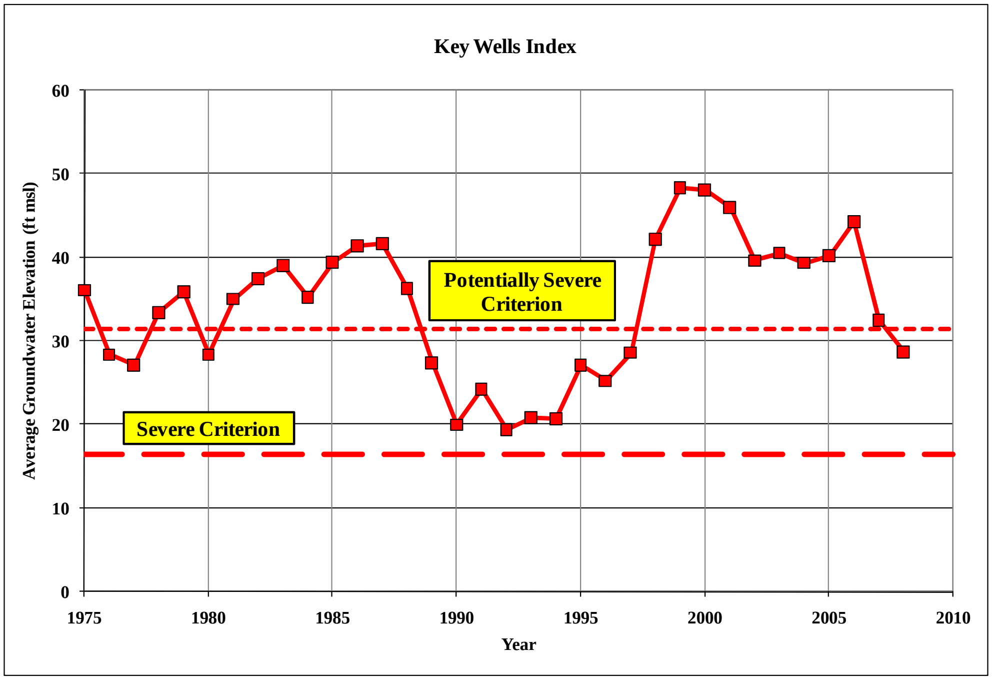
(1) The wells are geographically distributed.

(2) No single well overly influences the Index.

The first criterion was met in the selection of the wells. To meet the second criterion, groundwater elevations from each well were normalized so that any well where elevations were on the average higher or lower than the other wells did not overly influence the overall Index. This normalization was accomplished by dividing each Spring groundwater elevation measurement by the sum of all the Spring groundwater elevation data for that well.

The Index was defined for each year as the average of the normalized Spring groundwater data from each well. The lowest value of the Index could be considered the "historical low" within the NMMA. The sensitivity of that "historical low" was tested by examining the effect of eliminating a well from the Key Wells Index. Eight separate calculations of the Index from 1975 to 2008 were made by excluding the data from one of the eight wells, and computing the average value for each year from the remaining wells' normalized Spring groundwater data.

The criterion for a Potentially Severe Water Shortage Conditions should provide for enough time before the Severe criterion occurs to allow pumpers time to implement voluntary measures to mitigate a falling Key Wells Index. Based on the assumption that two years is adequate for this early warning, then the historical Index can be used to determine the potential rate of fall of the Index. The maximum drop in the historical Index over a two-year period was about 15 feet, during the last two years of the 1986-1991 drought. Thus, the criterion for Potentially Severe Water Shortage Conditions is set at 15 feet above the Severe Water Shortage Condition criterion, which calculates to **31.5 ft msl**. The Key Wells Index for all eight wells, which will be computed each year in the future, will be compared to the Potentially Severe and Severe criteria discussed above. The Index through 2008 is shown below.



Key Wells Index for the period 1975 to 2008. Upper dashed line is criterion for Potentially Severe Water Shortage Conditions and lower dashed line is criterion for Severe Conditions.

The Index generally tracks wet and dry climatic cycles, indicating the importance of natural recharge in the NMMA. Significant deviations from this climatic tracking could occur if supplemental water deliveries reduced pumping, if overlying land use changed the return flows to the aquifer, or if there was a large change in groundwater extractions in addition to those resulting from the introduction of the Supplemental Water.

A. Seawater Intrusion Criteria for Potentially Severe Water Shortage Conditions

The criteria for potentially severe conditions in coastal areas are either gradient conditions that could pull seawater into the principal aquifer, or threshold chloride concentrations detected in coastal monitoring wells. Whereas chloride is the principal indicator for the groundwater quality portion of this criteria, other groundwater quality constituents may be considered for future refinement of this criteria.

To avoid seawater contamination, groundwater elevations in the coastal monitoring wells must be sufficiently high to balance higher-density seawater (about 2.5 of extra head is required for every 100 ft of ocean depth of an offshore outcrop of the aquifer). Thus, if an aquifer is penetrated at 100 ft below sea level in a coastal well, it is assumed that groundwater elevations in that aquifer must be at least 2.5 ft above sea level to counteract the higher density of seawater. Although offshore outcrop areas are not currently defined, it is assumed that some hydraulic connection between the onshore aquifers and seawater at the sea floor is possible or even probable.

Historical groundwater elevation data from these coastal wells indicate that groundwater elevations have not always been higher than the theoretical elevations of fresh water to balance sea water, described in the preceding paragraph. It is not known to what extent (if any) that seawater has advanced toward the land during the periodic depression of groundwater elevation, nor has any groundwater quality data supported the indication that seawater has contaminated the fresh water aquifer at the coastal monitoring well locations. Thus, coastal groundwater elevation criteria must take into account the periodic depression of groundwater elevations. To accommodate these fluctuations and until further understanding is developed, the coastal criteria are presented in the table below, based on the lower of 1) historical low groundwater elevations in the coastal monitoring wells or 2) a calculation of 2.5 ft of elevation for every 100 ft of aquifer depth in the well. If the historical low elevation is used, the value is reduced by one foot and rounded to the nearest half-foot. Similarly, if a calculated value is the lower option, it is rounded to the nearest half-foot. The results of these criteria are indicated in the following table.

Criteria for Potentially Severe Water Shortage Conditions

Well	Perforations Elevation (ft msl)	Aquifer	Historic Low (ft msl)	2.5' per 100' Depth (ft msl)	Elevation Criteria (ft msl)	Highest Chloride (mg/L)	Chloride Concentration Criteria (mg/L)
11N/36W-12C1	-261 to -271	Paso Robles	5.8	6.5	**5.0**	81	**250**
11N/36W-12C2	-431 to -441	Pismo	6.3	10.8	**5.5**	55	**250**
11N/36W-12C3	-701 to -711	Pismo	10.1	17.5	**9.0**	98	**250**
12N/36W-36L1	-200 to -210	Paso Robles	4.3	5.7	**3.5**	38	**250**
12N/36W-36L2	-508 to -518	Pismo	10.1	13.4	**9.0**	127	**250**

The groundwater quality portion of the criteria is set at 250 mg/L chloride. There is no groundwater quality criterion for the shallow alluvium. Although there is no assumption that seawater intrusion has occurred at this concentration, the cause of the rise in chloride concentration must be investigated and appropriate mitigation measures taken. Thus, Potentially Severe Water Shortage Conditions are established if either the groundwater elevation or groundwater quality criteria are met.

B. Seawater Intrusion Criteria for Severe Water Shortage Conditions

One criterion for Severe Water Shortage Conditions is the occurrence of conditions that result in chloride concentration(s) in groundwater greater than the drinking water standard in any of the coastal monitoring wells.

A principal threat for such occurrence is from seawater intrusion. The first evidence of seawater intrusion can occur very quickly or may involve a slower and more subtle change. Because the rate of change for chloride concentrations during seawater intrusion is difficult to predict for the NMMA, the criterion is set to the Maximum Contaminant Level for chloride in drinking water.

The Nipomo Mesa Technical Group set the coastal criterion for Severe Water Shortage Conditions at a chloride concentration at or above **500 mg/L** in any of the coastal monitoring wells. If the criterion is exceeded, an additional sample will be collected and analyzed from that well as soon as practically possible to verify the result. The Severe Water Shortage Condition will not be in effect until the laboratory analysis has been verified.

Appendix C: Well Management Plan

NMMA PURVEYOR

NMMA WELL MANAGEMENT PLAN[1]

Adopted January 21, 2010

Stage 1: Potentially Severe Water Shortage Conditions

- Potentially Severe Water Shortage Conditions Triggered[2];
- Voluntary measures urged by Water Purveyors (NCSD, GSWC, Woodlands, and RWC). See list of "Recommended Water Use Restrictions;"
- Voluntary evaluation of sources of new supplemental water;
- Voluntary purveyor conservation goal of 15% (Baseline to be suggested by the NMMA TG);
- Voluntary/Recommended public information program;
- Voluntary evaluation and implementation of shifting pumping to reduce GW depressions and/or protect the seaward gradient. This includes the analysis and establishment of a potential network of purveyor system interties to facilitate the exchange of water;

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[1] This Well Management Plan is required by the terms of the Stipulation (page 22). The Well Management Plan provides for steps to be taken by the NCSD, GSWC, Woodlands and RWC under a factual scenario where Nipomo Supplemental Water (a defined term in the Stipulation) has not been "used" in the NMMA (page 22). The Well Management Plan, therefore, has no applicability to either ConocoPhillips or Overlying Owners as defined in the Stipulation (page 22).

[2] Water shortage conditions are characterized by criteria designed to reflect that groundwater levels beneath the NMMA as a whole are at a point at which a response would be triggered to avoid further declines in the groundwater levels (potentially severe), and to declare that the lowest historic groundwater levels beneath the NMMA as a whole have been reached or that conditions constituting seawater intrusion have been reached (severe). See current version of Water Shortage Conditions and Response Plan – appendix to Annual Report.

Stage 2: Severe Water Shortage Conditions

- Severe Water Shortage Conditions Triggered and Nipomo Supplemental Water has been used in the NMMA (see footnote 1)[3];

- Overlying landowners other than Woodlands and ConocoPhillips shall reduce groundwater use to no more than 110% of the highest pooled base year prior to the transmittal of Nipomo supplemental water. The NMMA TG will determine a technically responsible and consistent method to determine the pooled amount and an individual's contribution (To be determined when trigger occurs). The method of reducing pooled production to 110% is to be prescribed by the TG and approved by the court. Landowners may consider using less water for consideration received;

- ConocoPhillips shall reduce its yearly groundwater use to no more than 110% of the highest amount it used in a single year prior to the transmittal of Nipomo supplemental water. ConocoPhillips may consider using less water for consideration received and has discretion to determine how its groundwater reduction is achieved;

- Water Purveyors (NCSD, GSWC, Woodlands, and RWC) shall implement mandatory conservation measures. Where possible, institute mandatory restrictions with penalties;

- The mandatory conservation goals will be determined by the NMMA TG when the Severe water shortage trigger is reached. Annually, should conditions worsen; the NMMA TG will re-evaluate the mandatory conservation goal;

- Measures may include water reductions, additional water restrictions, and rate increases. GSWC and RWC shall aggressively file and implement[4] a schedule 14.1 mandatory rationing plan with the CPUC consistent with the mandatory goals;

- Penalties, rates, and methods of allocation under the rationing program shall be at the discretion of each entity and its regulating body;

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[3] [see comment at footnote #1] Water shortage conditions are characterized by criteria designed to reflect that groundwater levels beneath the NMMA as a whole are at a point at which a response would be triggered to avoid further declines in the groundwater levels (potentially severe), and to declare that the lowest historic groundwater levels beneath the NMMA as a whole have been reached or that conditions constituting seawater intrusion have been reached (severe). See current version of Water Shortage Conditions and Response Plan (appendix to Annual Report).

[4] CPUC has the authority to set rates and allow mandatory conservation actions. As CPUC regulated entities, GSWC and RWC cannot implement such programs without CPUC approval.

- Aggressive voluntary public information program which includes discussions with high use water users such as school districts, parks, and golf courses to seek voluntary reductions in potable water irrigation;

List of Recommended Water Use Restrictions

The following provisions are examples of what may be considered prohibited, nonessential, and/or unauthorized water use:

1) Prohibit nonessential and unauthorized water use, including but not limited to:
   a) Use of potable water for more than minimal landscaping, as defined in the landscaping regulated of the jurisdiction or as described in Article 10.8 of the California Government Code in connection with new construction;
   b) Use through any meter when the company has notified the customer in writing to repair a broken or defective plumbing, sprinkler, watering or irrigation system and the customer has failed to effect such repairs within five business days;
   c) Use of potable water which results in flooding or runoff in gutters or streets;
   d) Individual private washing of cars with a hose except with the use of a positive action shut-off nozzle. Use of potable water for washing commercial aircraft, cars, buses, boats, trailers, or other commercial vehicles at any time, except at commercial or fleet vehicle or boat washing facilities operated at a fixed location where equipment using water is properly maintained to avoid wasteful use;
   e) Use of potable water washing buildings, structures, , driveways, patios, parking lots, tennis courts, or other hard-surfaced areas, except in the cases where health and safety are at risk;
   f) Use of potable water to irrigate turf, lawns, gardens, or ornamental landscaping by means other than drip irrigation, or hand watering without quick acting positive action shut-off nozzles, on a specific schedule, for example: 1) before 9:00 a.m. and after 5:00 p.m.; 2) every other day; or 3) selected days of the week;
   g) Use of potable water for watering streets with trucks, except for initial wash-down for construction purposes (if street sweeping is not feasible), or to protect the health and safety of the public;
   h) Use of potable water for construction purposes, such as consolidation of backfill, dust control, or other uses unless no other source of water or other method can be used.

i) Use of potable water for construction purposes unless no other source of water or other method can be used;

j) Use of potable water for street cleaning;

k) Operation of commercial car washes without recycling at least 50% of the potable water used per cycle;

l) Use of potable water for watering outside plants, lawn, landscape and turf areas during the hours of 9:00 am to 5:00 pm;

m) Use of potable water for decorative fountains or the filling or topping off of decorative lakes or ponds. Exceptions are made for those decorative fountains, lakes, or ponds which utilize recycled water;

n) Use of potable water for the filling or refilling of swimming pools.

o) Service of water by any restaurant except upon the request of a patron; and

p) Use of potable water to flush hydrants, except where required for public health or safety.

NMMA WATER SHORTAGE RESPONSE STAGES

Endorsed by NMMA Technical Group April 14, 2014

STAGE	GROUNDWATER SUPPLY CONDITION	RESPONSE - GENERAL DESCRIPTION*	DURATION of RESTRICTION
I	Always in place.	Voluntary measures and outreach to encourage best water management practices and conservation.	Always in place.
II	Potentially Severe Water Shortage Condition declaration pursuant to NMMA Water Shortage Condition and Response Plan.	Goal: voluntary 20% reduction in groundwater production – supported with aggressive public outreach and customer communications.	Until Potentially Severe Water Shortage Condition does not exist.
III	Severe Water Shortage Condition declaration pursuant to NMMA Water Shortage Condition and Response Plan.	Goal: 30% reduction in groundwater production – supported with mandatory conservation restrictions.	Until Severe Water Shortage Conditions no longer exist pursuant to NMMA criteria.**
IV	Severe Water Shortage Condition declaration pursuant to NMMA Water Shortage Condition and Response Plan, lasting more than 1 year from the initial declaration; or Severe Water Shortage declaration pursuant to NMMA declaration triggered by both the Key Well Index and the Coastal Area Criterion.	Goal: 50% reduction in groundwater production – supported with mandatory conservation restrictions.	Until Severe Water Shortage Conditions no longer exist pursuant to NMMA criteria.
V	Severe Water Shortage Condition declaration pursuant to NMMA Water Shortage Condition and Response Plan, lasting more than 2 years from the initial declaration, based on both the Key Well Index and Coastal Area Criterion.	Goal: 60% reduction in groundwater production – supported with mandatory conservation restrictions.	Until Severe Water Shortage Conditions no longer exist pursuant to NMMA criteria.

* This is a general descriptor. Detailed response to meeting the applicable goal is the responsibility of each NMMA purveyor. The NMMA parties acknowledge that Golden State Water Company and Rural Water Company must obtain CPUC approval and hold public hearings before implementing any aspect of this water shortage response.

** The Technical Group may determine Severe Water Shortage Conditions no longer exists when groundwater quality criteria threshold are no longer exceeded in a single measurement.

General Notes

1. Potentially Severe and Severe Water Shortage Conditions, Key Well Index and Coastal Area Criteria are defined in the NMMA Water Shortage Conditions Response Plan, April 13, 2009.
2. Reductions goals are to be based on average usage, prior to the delivery of supplemental water, as follows:
    a. For Woodlands Mutual Water Company – based on average same month production for a single year prior to declaration of Stage III.
    b. For Nipomo CSD, Golden State Water Company and Rural Water Company – based on average same month production for the five years prior to declaration of Stage III. Individual purveyors may use other baselines in their respective responses if dictated by their respective regulatory bodies.
3. Each NMMA purveyor will implement programs to meet the reduction levels.
4. When drought Stage III or higher is in effect, Managers will meet monthly to report previous months production and coordinate efforts.
5. The Technical Group may revisit and revise this response plan should conditions change and after the full implementation of the Nipomo Supplemental Water deliveries.

Appendix D: Data Acquisition Protocol for Groundwater Level Measurement for the Nipomo Mesa Management Area

Data Acquisition Protocol for Groundwater Level Measurement for the Nipomo Mesa Management Area

Introduction

The purpose of this memorandum is to establish a protocol for measuring and recording groundwater levels for Nipomo Mesa Management Area (NMMA) wells, and to describe various methods used for collecting meaningful groundwater data. Static groundwater levels obtained for the NMMA monitoring program are determined by measuring the distance to water in a non-pumping well from a measuring point that has been referenced to sea level. Subtracting the distance to water from the elevation of the measuring point determines groundwater surface elevations above or below sea level. This is represented by the following equation:

$$E_{GW} = E_{MP} - D$$

Where:

E_{GW} = Elevation of groundwater above mean sea level (feet)
E_{MP} = Elevation above sea level at measuring point (feet)
D = Depth to water (feet)

Groundwater elevation data can be used to construct groundwater contour maps, determine groundwater flow direction and hydraulic gradients, show locations of groundwater recharge, determine amount of water in storage, show changes in groundwater storage over time, and identify other aquifer characteristics. Miss-representation of aquifer conditions result from errors introduced during water level measurements, from a changed measuring point, during data recording, from equipment problems, or from using inappropriate measuring equipment or techniques for a particular well.

In an effort to minimize such errors and to standardize the collection of groundwater data, the U.S. Geological Survey (U.S.G.S.) has conducted extensive investigations into methods for measuring groundwater levels. In conjunction with several other federal agencies, the U.S.G.S. published the "National Handbook of Recommended Methods for Water-Data Acquisition" (1977); "Introduction to Field Methods for Hydrologic and Environmental Studies, (2001); and several Stand-alone Procedure Documents (GWPD, 1997). Excerpts from these publications relating to water-level measurements are attached. The following protocol for obtaining and reporting accurate data, including a discussion of potential errors associated with several measurement techniques, are based on these U.S.G.S. documents.

Well Information

To give the most meaningful value to the data obtained in the NMMA monitoring program, each well file should include as much information as is available. Table 1 below lists important well information to be maintained in a well file or in a field notebook. Additional information that should be available to the person collecting water-level data should include a description of access to the property and the well, the presence and depth of cascading water, or downhole obstructions that could interfere with a sounding cable. San Luis Obispo County Department of Public Works maintains well cards on the wells in the County monitoring network.

Table 1
Well File Information

Well Completion Report	Hydrologic Information	Additional Information to be Recorded
Well name	Map showing basin boundaries and wells	Township, Range, and ¼ ¼ Section
Well Owner	Name of groundwater basin	Latitude and Longitude (Decimal degrees)
Drilling Company	Description of aquifer	Assessor's Parcel Number
Location map or sketch	Confined, unconfined, or mixed aquifers	Description of well head and sounding access
Total depth	Pumping test data	Measuring point & reference point elevations
Perforation interval	Hydrographs	Well use and pumping schedule if known
Casing diameter	Water quality data	Date monitoring began
Date of well completion		Land use

Types of Wells

The monitoring program is likely to include several types of wells with various means of access and pumping schedules. It is important to understand the characteristics of each well type and its downhole conditions to best determine monitoring schedules and appropriate measuring technique. Below is a brief summary of well types and their pumping characteristics. A more detailed description of these well types is included in the attached “National Handbook of Recommended Methods for Water-Data Acquisition”.

<u>Existing Wells</u>
These include abandoned wells, irrigation wells, public supply wells, and domestic wells. Existing wells provide convenient and inexpensive measuring sites; however, they should be carefully evaluated to show that they can provide accurate data under static conditions with reliable access.

Abandoned wells are often in poor condition and may have partially collapsed casing or accumulated sediments. Damaged casing may also result in cascading water. An undamaged well with the pump removed, however, can provide easy access and reliable water-level data.

Irrigation wells are generally pumped on a regular schedule, allowing static water-level measurements to be taken during known non-pumping periods. Seasonal changes in the pumping schedules should also be noted when planning monitoring events.

Public supply wells may be part of a monitoring program if sufficient information regarding their operations is available. Hydrographs showing periods or pumping and recovery should be obtained to determine the best time to measure static water levels.

Domestic wells are generally pumped frequently and for short durations, making it difficult to monitor during static conditions. Determining when the lowest domestic water use occurs during the day can facilitate monitoring schedules.

Observation Wells

These wells are designed for specific sites and depths in known hydrogeologic conditions to supply desired information. Typically, there is no permanent pump, making measurements relatively easy.

Piezometers

A piezometer is a small diameter observation well designed to measure the hydraulic head within a small zone. It should have a very short screen and filter pack interval so it can represent the hydraulic head at a single point within the aquifer.

Access to Supply Wells

Access into a well to obtain a water level measurement depends on pump types and wellhead construction. For turbine-pump wells, there is typically an opening between the pump column and the casing either through a port or between the base plate and the casing. The filter-pack fill tube should not be confused with a casing vent or sounding access pipe. In some wells, there is no access for a downhole measuring tape; however, the well may be equipped with an air-line measuring system.

Access to submersible wells is generally through a small diameter plug located in the plate on top of the casing. In wells where there is no sounding tube, caution should be used during water level measurements to minimize the chance of the sounding tape becoming entangled with the power cable. Additional information and wellhead diagrams regarding supply well access is found in the attached "National Handbook of Recommended Methods for Water-Data Acquisition".

Measuring Points and Reference Points

Measuring point (MP) elevations are the basis for determining groundwater elevations relative to sea level. The MP is generally that point on the well head that is the most convenient place to measure the water level in a well. In selecting an MP, an additional consideration is the ease of surveying either by Global Positioning System (GPS) or by leveling.

The MP must be clearly defined, well marked, and easily located. If permissible, the point should be labeled with the letters MP and an arrow. A description, sketch, and photograph of the point should be included in the well file.

The Reference Point (RP) is a surveyed point established near the wellhead on a permanent object. It serves as a benchmark by which the MP can be checked or re-surveyed if the MP is changed. The RP should be marked, sketched, photographed, and described in the well file.

All MPs and RPs for the NMMA monitored wells should be surveyed using the same horizontal and vertical datum by a California licensed surveyor to the nearest tenth of one foot vertically, and the nearest one foot horizontally. The surveyor's report should be maintained in the project file.

In addition to the MP and RP survey, the elevation of the ground surface adjacent to the well should also be surveyed and recorded in the well file. Because the ground surface adjacent to a well is rarely uniform, the average surface level should be estimated. This average ground surface elevation is referred to in the U.S.G.S. Procedural Document (GWPD-1, 1997) as the Land Surface Datum (LSD).

Water-Level Data Collection

Prior to beginning the field work, the field technician should review each well file to determine which well owners require notification of the upcoming site visit, or which well pumps need to be turned off to allow for water level recovery. Because groundwater elevations are used to construct groundwater contour maps and to determine flow direction, all water level measurements should be collected within a 24-hour period or within as short a period as possible. Weather and groundwater conditions are least likely to change significantly during a short period for data collection. For an individual well, the same measuring method and the same sounder should be used during each sampling event where practical.

Prior to taking a measurement, the length of time since a pump has been operating should be determined. If possible, a domestic well should be allowed to recover at least one half hour prior to measuring, whereas an irrigation or public well should recover a minimum of eight hours prior to measuring. If the well is capped but not vented, remove the cap and wait several minutes before measurement to allow water levels to equilibrate to atmospheric pressure.

When there is doubt about whether water levels in a well are continuing to recover, repeated measurements should be made. Or, if an electric sounder is being used, it is possible to hold the sounder level at one point just above the known water level and wait for a signal that would indicate rising water. For each well, the general schedule of pump operation should be determined and noted.

When lowering a graduated steel tape (chalked tape) or electric tape in a well without a sounding tube in an equipped well, the tape should be played out slowly by hand to minimize the chance of the tape end becoming caught in a downhole obstruction. The tape should be held in such a way that any change in tension will be felt. When withdrawing a sounding tape, it should also be brought up slowly so that if an obstruction is encountered, tension can be relaxed so that the tape can be lowered again before attempting to withdraw it around the obstruction.

All water level measurements should be made to an accuracy of 0.1 feet. The field technician should make at least two measurements. If measurements of static levels do not agree within 0.1 feet , the technician should continue measurements until the reason for the disparity is determined, or the measurements are within 0.1 feet.

Where groundwater levels are found to be above ground surface, a sensitive pressure gage can be used to determine the height above the measuring point or a sealed well could have a manometer tube that would show the height above ground surface. A manometer tube may not be high enough to measure the water level if the groundwater is under more than 5 feet of pressure.

Record Keeping in the Field

The information recorded in the field is often the only remaining evidence of the conditions at the time of the monitoring event. It is important that the field book be protected carefully and that it contains the name of the field technician and appropriate contact information. Because the field book contains original tables of multiple monitoring events, copies of the tables should be made following each monitoring event. The data can be further protected by entering the data electronically as soon as practicable.

All field notes must be recorded during the time the work is being done in the field. Accurate documentation of field conditions cannot be made after the field technician has returned to the office. Because much of the data will be reviewed by office staff, and because more than one field technician may participate in the monitoring program, it is essential that notes be intelligible to anyone without requiring a verbal explanation. As a means to support field information, sketches or digital photos attached to field notes should be encouraged.

All field notes should be made with a sharp pencil with lead appropriate for the conditions. Erasures should not be made when recording data. A single line should be drawn through an error without obscuring its legibility, and the correct value or information should be written adjacent to it or in a new row below it.

During each monitoring event it is important to record any conditions at a well site and its vicinity that may affect groundwater levels, or the field technician's ability to obtain groundwater levels. Table 2 lists important information to record, however, additional information should be included when appropriate. Table 3, The Water Level Measurement Form, is a suggested format for recording field data.

Table 2
Information Recorded at Each Well Site

Well name	Property access conditions	Downhole obstructions
Name and organization of field technician	Changes in land use	Presence of oil in well
Date & time (time in 24-hour notation)	Changes in MP	Cascading water
Measurement method used	Nearby wells in use	Equipment problems
Sounder used	Weather conditions	Physical changes in wellhead
Most recent sounder calibration	Recent rainfall events	Comments

Measurement Techniques

Four standard methods of obtaining water levels are discussed below. The chosen method depends on site and downhole conditions, and the equipment limitations. In all monitoring situations, the procedures and equipment used should be documented in the field notes and in final reporting. Additional detail on manual methods of water level measurement is included in the attached U.S.G.S. Stand-Alone Procedure Documents and the "National Handbook of Recommended Methods for Water-Data Acquisition". The attached "Introduction to Field Methods for Hydrologic and Environmental Studies" includes a discussion of pressure transducers.

Graduated Steel Tape

This method uses a graduated steel tape with a brass or stainless steel weight attached to its end. The tape is graduated in feet. The approximate depth to water should be known prior to measurement.

- Chalk the lower few feet of the tape by applying blue carpenter's chalk.
- Lower the tape to just below the estimated depth to water so that a few feet of the chalked portion of the tape is submerged. Be careful not to lower the tape beyond its chalked length.
- Hold the tape at the MP and record the tape position (this is the "hold" position and should be at an even foot);
- Withdraw the tape rapidly to the surface;
- Record the length of the wetted chalk mark;
- Subtract the wetted chalk number from the "hold" position number and record this number in the "Depth to Water below MP" column;
- Perform a check by repeating the measurement using a different MP hold value;
- All data should be recorded to the nearest 0.01 foot;
- Disinfect the tape by pouring a small amount of chlorine bleach on a clean cloth and wiping down the portion of the tape that was submerged below the water surface.

The graduated steel tape is generally considered to be the most accurate method for measuring static water levels. Measuring water levels in wells with cascading water or with condensing water on the well casing causes potential errors, or can be impossible. The tape should be calibrated against another steel tape that is maintained in the office and is used only for calibration.

Electric Tape

An electric tape operates on the principle that an electric circuit is completed when two electrodes are submerged in water. Most electric tapes are mounted on a hand-cranked reel equipped with batteries and an ammeter, buzzer or light to indicate when the circuit is closed. Tapes are graduated in either one-foot intervals or in hundredths of feet depending on the manufacturer. Like graduated steel tapes, electric tapes are attached with brass or stainless steel weights.

- Check the circuitry of the tape before lowering the probe into the well by dipping the probe into water and observe if the ammeter needle or buzzer/light signals that the circuit is closed;
- Lower the probe slowly and carefully into the well until the signal indicates that the water surface has been reached;

- Place a finger or thumb on the tape at the MP when the water surface is reached;
- If the tape is graduated in one-foot intervals, partially withdraw the tape and measure the distance from the MP mark to the nearest one-foot mark to obtain the depth to water below the MP. If the tape is graduated in hundredths of a foot, simply record the depth at the MP mark as the depth to water below the MP;
- Make all readings using the same needle deflection point on the ammeter scale (if equipped) so that water levels will be consistent between measurements;
- Make check measurements until agreement shows the results to be reliable;
- All data should be recorded to the nearest 0.01 foot;
- Disinfect the tape by pouring a small amount of chlorine bleach on a clean cloth and wiping down the submerged portion of the tape;
- Periodically check the tape for breaks in the insulation. Breaks can allow water to enter into the insulation creating electrical shorts that could result in false depth readings.

<u>The electric tape may give slightly less accurate results than the graduated steel tape.</u> Errors can result from signal "noise" in cascading water, breaks in the tape insulation, or tape stretch. Electric tape products graduated in hundredths of a foot generally give more accurate results than electric tapes graduated in one-foot intervals. This accuracy difference is due to less stretch and ease of measurement in the tapes graduated in hundredths of a foot. All electric tapes should be calibrated periodically against a steel tape that is maintained in the office and used only for calibration.

<u>Air Line</u>
The air line method is usually used only in wells equipped with pumps. This method typically uses a 1/8 or 1/4-inch diameter, seamless copper tubing, brass tubing, or galvanized pipe with a suitable pipe tee for connecting an altitude or pressure gage. Plastic tubing may also be used, but is considered less desirable. An air line must extend far enough below the water level that the lower end remains submerged during pumping of the well. The air line is connected to an altitude gage that reads directly in feet of water, or to a pressure gage that reads pressure in pounds per square inch (psi). The gage reading indicates the length of the submerged air line.

The formula for determining the depth to water below the MP is: $\mathbf{d = k - h}$ where d = depth to water; k = constant; and h = height of the water displaced from the air line. In wells where a pressure gage is used, h is equal to 2.31 ft/psi multiplied by the gage reading. The constant value for k is approximately equivalent to the length of the air line.

- Calibrate the air line by measuring an initial depth to water (d) below the MP with a graduated steel tape. Use a tire pump, air tank, or air compressor to pump compressed air into the air line until all the water is expelled from the line. When all the water is displaced from the line, record the stabilized gage reading (h). Add d to h to determine the constant value for k.
- To measure subsequent depths to water with the air line, expel all the water from the air line, subtract the gage reading (h) from the constant k, and record the result as depth to water (d) below the MP.

The air line method is not as accurate as a graduated steel tape or electric tape. Measurements with an altitude gage are typically accurate to approximately 0.1 foot, and measurements using a pressure gage are accurate to the nearest one foot at best. Errors can occur with leaky air lines, or when tubing becomes clogged with mineral deposits or bacterial growth.

Submersible Pressure Transducers

Electrical pressure transducers make it possible to collect frequent and long-term water-level or pressure data from wells. These pressure-sensing devices, installed at a fixed depth in a well, sense the change in pressure against a membrane. The pressure changes occur in response to changes in the height of the water column in the well above the transducer. To compensate for atmospheric changes, transducers may have vented cables or they can be used in conjunction with a barometric transducer that is installed in the same well or a nearby observation well above the water level.

Transducers are selected on the basis of expected water-level fluctuation. The smallest range in water levels provides the greatest measurement resolution. Accuracy is generally 0.01 to 0.1 percent of the full scale range.

Retrieving data in the field is typically accomplished by downloading data through a USB connection to a portable "lap-top" computer. A site visit to retrieve data should involve several steps designed to safeguard the data and the continued useful operation of the transducer:

- Inspect the wellhead and check that the transducer cable has not moved or slipped;
- Ensure that the instrument is operating properly;
- Measure and record the depth to water with a graduated steel or electric tape;
- Document the site visit, including all measurements and any problems;
- Retrieve the data and document the process;
- Review the retrieved data by viewing the file or plotting the original data;
- Recheck the operation of the transducer prior to disconnecting from the computer.

A field notebook with a checklist of steps and measurements should be used to record all field observations and the current data from the transducer. It provides an historical record of field activities. In the office, maintain a binder with field information similar to that recorded on the field notebook so that a general historical record is available there and can be referred to before and after a field trip.

Summary and Recommendations

Static groundwater levels obtained for the NMMA monitoring program are determined by measuring the distance to water from wellhead MPs that have been surveyed using an accepted sea level-based datum. Subtracting the distance to water from the elevation of an MP determines groundwater surface elevations above or below sea level. The following items should be considered important to creating and maintaining a successful monitoring program:

- All wells should be surveyed by a licensed surveyor;

- Three survey points should be set for each well: the MP on the wellhead, the RP on a nearby permanent object, and the adjacent ground surface;
- The points should be surveyed to the nearest tenth of one foot vertically, and the nearest one foot horizontally;
- A one-inch diameter water-level sounding tube should be installed in each NMMA monitoring program well;
- Static water levels should always be measured to the nearest 0.01 feet from the same measuring point, using the same measuring techniques for each well;
- Measurement techniques using graduated steel tapes, electric tapes graduated in hundredths of feet, or pressure transducers should be considered appropriate for the monitoring program;
- Because of its lower accuracy and higher potential for errors than other methods, the air-line method should not be used in the program;
- Thorough and accurate field documentation and complete project files are essential to a successful monitoring program.

Appendix E: Additional Data and Maps

To estimate the annual amount of pumped groundwater used for crop irrigation in the NMMA, land use data are used together with crop water use estimates and local climate data. A spreadsheet model with a daily time step keeps track of various parameters, including evapotranspiration, precipitation, soil moisture, crop water requirements, and related information, to estimate how much irrigation water is required for a crop and, during wet periods, how much precipitation is recharged to the aquifer.

The model estimates a crop's water requirement, otherwise known as the evapotranspirative requirement (ET_C), based on the local weather and a crop coefficient (K_C), and keeps track of soil moisture. The crop coefficient is an estimated value that accommodates seasonal conditions such as growth stage and canopy cover. Reference evapotranspiration (ET_O) values used in the model are obtained from a California Irrigation Management Information System (CIMIS) station in Nipomo, which provides daily meteorological data.

Crop Water Requirement:

$ET_C = K_C * ET_O$ where

ET_C = crop evapotranspirative requirement
K_C = crop coefficient
ET_O = reference evapotranspiration (data from Nipomo CIMIS station)

The model then keeps track of the amount of water on a daily time-step that is needed to grow the crop, and whether that water first comes from precipitation (P) and then from soil water. When the total amount of soil water is reduced to half or less of the soil's water-holding capacity (calculated together with the crop's rooting depth), it is assumed that application of water via irrigation (AW_T) will occur to replenish the soil water.

Crop Evapotranspiration of Applied Water:

$AW_T = ET_C – P$ where

AW_T = total applied crop water
P = precipitation

The NMMA TG modified the methodology used to estimate the annual amount of pumped groundwater used for crop irrigation and parameter values used in the model calculation in 2010. The crop coefficients, K_C, and land use areas were subsequently updated in 2013 compared to those used in 2012 (this Annual Report; see Tables 1 and 2 below).

Table 1: Crop Coefficients (K_c) assigned to Land Use categories for 2012.

Crop Coefficient (Kc)											
	Native		Agriculture							Golf Course	
Month	Grasses	Trees and Shrubs	Deciduous	Pasture	Vegetable Rotational	Avocado and Lemon	Strawberries	Nursery	Un-irrigated Ag Land	Golf Course	Urban
1	0.42	0.89	1.33	1.33	1.33	0.40	0.18	0.50	1.33	0.60	0.42
2	0.42	1.33	0.31	0.31	1.00	0.50	0.36	0.50	0.31	0.60	0.42
3	0.42	1.26	0.58	1.00	1.00	0.55	0.56	0.50	0.13	0.60	0.42
4	0.42	1.49	0.72	1.00	1.00	0.55	0.65	0.50	0.08	0.60	0.42
5	0.42	1.47	0.83	1.00	0.51	0.60	0.68	0.50	0.03	0.60	0.42
6	0.00	1.67	0.90	1.00	0.01	0.65	0.69	0.50	0.01	0.60	0.42
7	0.00	1.64	0.96	1.00	0.49	0.65	0.35	0.50	0.00	0.60	0.42
8	0.00	1.38	0.96	1.00	1.00	0.65	0.05	0.50	0.05	0.60	0.42
9	0.42	1.63	0.92	1.00	1.00	0.60	0.13	0.50	0.13	0.60	0.42
10	0.42	1.28	0.81	1.00	1.00	0.55	0.12	0.50	0.12	0.60	0.42
11	0.42	0.95	0.54	0.54	0.54	0.55	0.54	0.50	0.54	0.60	0.42
12	0.42	0.87	1.20	1.20	1.20	0.50	1.20	0.50	1.20	0.60	0.42

Table 2: Crop Coefficients (K_c) assigned to Land Use categories for 2013.

Crop Coefficient (Kc)											
	Native		Agriculture							Golf Course	
Month	Grasses	Trees and Shrubs	Grape	Pasture	Vegetable Rotational	Avocado and Lemon	Strawberries and cane berries	Nursery	Un-irrigated Ag Land	Golf Course	Urban
1	0.42	0.89	0.00	0.54	0.65	0.54	0.78	0.65	1.33	1.00	0.42
2	0.42	1.33	0.00	0.54	0.65	0.31	0.78	0.65	0.31	1.00	0.42
3	0.42	1.26	0.00	1.00	0.65	0.58	0.78	0.65	0.13	1.00	0.42
4	0.42	1.49	1.00	1.00	0.65	0.72	0.78	0.65	0.08	1.00	0.42
5	0.42	1.47	1.00	1.00	0.65	0.83	0.78	0.65	0.03	1.00	0.42
6	0.00	1.67	1.00	1.00	0.65	0.90	0.78	0.65	0.01	1.00	0.42
7	0.00	1.64	0.00	1.00	0.65	0.96	0.78	0.65	0.00	1.00	0.42
8	0.00	1.38	0.00	1.00	0.65	0.96	0.78	0.65	0.05	1.00	0.42
9	0.42	1.63	0.00	1.00	0.65	0.92	0.78	0.65	0.13	1.00	0.42
10	0.42	1.28	0.00	1.00	0.65	0.81	1.00	0.65	0.12	1.00	0.42
11	0.42	0.95	0.00	0.54	0.65	0.54	0.78	0.65	0.54	1.00	0.42
12	0.42	0.87	0.00	0.54	0.65	0.54	0.78	0.65	1.20	1.00	0.42

The golf course, nursery, and pasture K_C values (Table 2) were calculated from measured irrigation in portions of the NMMA. Strawberry and cane berry, vegetable rotational, and citrus and avocado K_C values were derived from known water demands for these crops in nearby coastal regions.

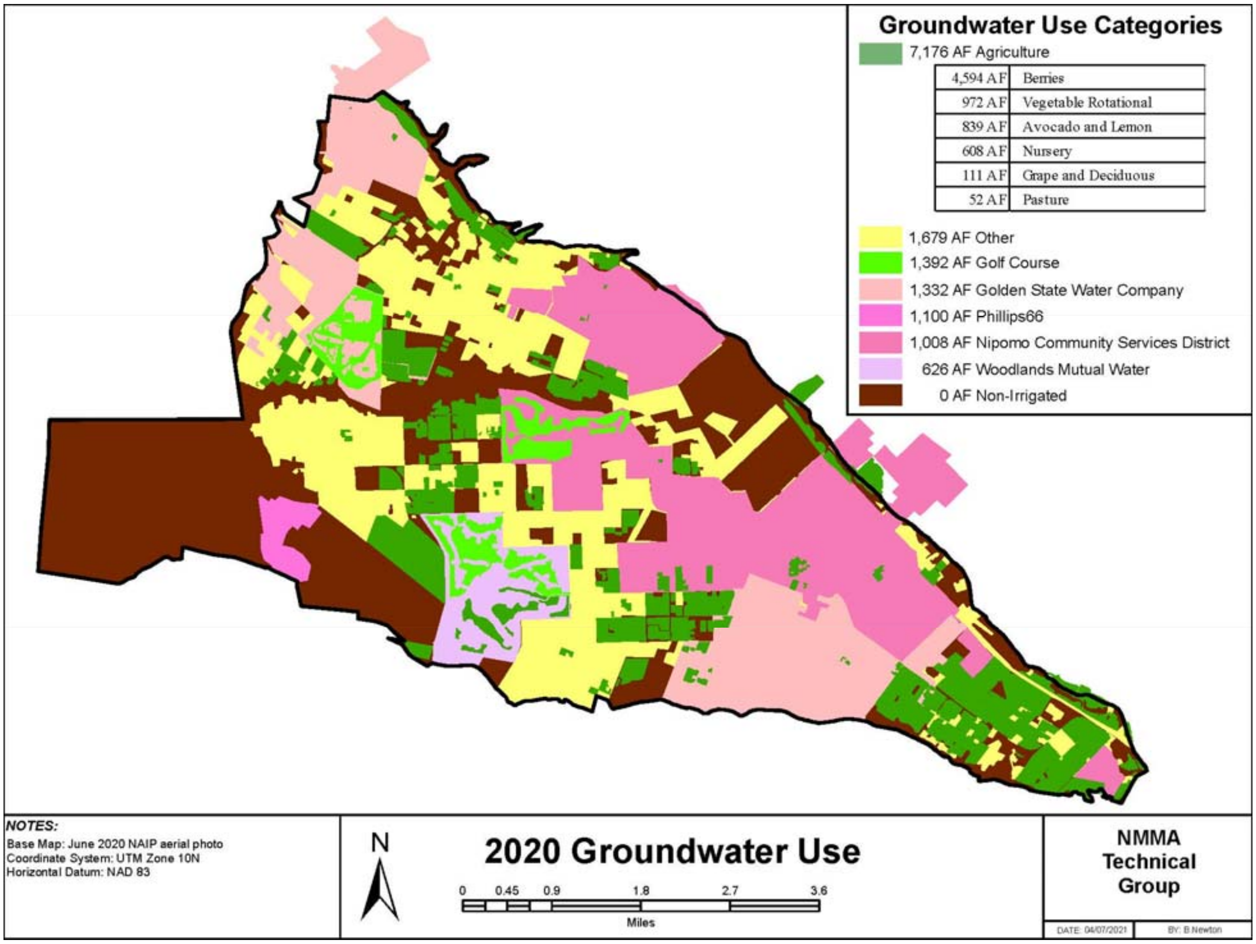

Figure 3-9. 2020 Groundwater Use